GNHWPCA

Greater New Haven Water Pollution Control Authority

260 East Street • New Haven CT 06511

Wastewater Treatment System Condition Assessment and Capital Program Report

January 2012

Report Prepared By:

Malcolm Pirnie, The Water Division of ARCADIS

44 S. Broadway, 15th Floor

White Plains, NY 10602

MALCOLM PIRNIE | ARCADIS

The Water Division of ARCADIS

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A condition assessment of the Critical Equipment Assets of the Greater New Haven Water Pollution Control Authority (the Authority or GNHWPCA) was conducted in September, 2011. The information developed as part of this assessment will serve to document the current condition of the major assets and as a basis for developing maintenance and capital improvement requirements moving forward. A revised draft of the Report was issued to the GNHWPCA in December 2011. This January 2012 Report incorporates comments provided by the GNHWPCA and replaces the December 2011 Report.

Approach

To assist the Authority in prioritizing capital improvement requirements, our approach to the project combined: a) a physical condition assessment, b) interviews with Authority and Operations Management International (OMI) staff, and c) a review and analysis of potential repair and replacement costs. The review was based on a 2003 study of equipment replacement costs, which had been originally used to establish the appraisal value of the Authority's system prior to regionalization.

The condition assessment began with site visits to the East Shore Water Pollution Abatement Facility (WPAF), pump stations selected by the Authority, and the James Street Siphon. Pirnie performed these site visits in September 2011. The assessment team consisted of Malcolm Pirnie (Pirnie) senior operations and design staff with process mechanical, electrical, HVAC, and structural specialties, together with Authority and OMI staff. Team members visited the WPAF and pump stations and conducted a qualitative assessment of critical equipment physical condition and functionality. The qualitative assessment consisted primarily of visual and sound observations. Authority and OMI staff who accompanied the assessment team were interviewed about the equipment. Their input was used to assess equipment maintenance history and reliability based on their experience and knowledge of the maintenance records.

This Condition Assessment Report (Report) presents a summary of the observations resulting from our field inspections along with order-of-magnitude budgetary cost estimates for those prioritized critical assets requiring repair or replacement.

Condition Assessment

In general, large, critical mechanical equipment at the WPAF, such as main sewage pumps and aeration blowers, are in relatively good condition. This equipment has been recently replaced or overhauled, and can be expected to provide many more years of

useful service. However, certain areas of the plant are in a deteriorated state and equipment are past their useful lives, requiring significant corrective maintenance. This is most notable in the headworks area. It is our assumption that major capital investments in such areas were not made because complete upgrades are planned under the Wet Weather Capacity Improvements and Nitrogen Reduction Project. Because this project has been delayed, the equipment planned for upgrade has continued to deteriorate. If further delays in these upgrade projects are envisioned, a decision must be made to replace some of this equipment in a piecemeal fashion.

Mechanical equipment was ranked on a scale of 1 to 5 for various criteria, such as corrosion, leakage, vibration, etc. Structures were also ranked on a scale of 1 to 5 for criteria including cracking, settling, delamination, etc. A rating of 1 indicates excellent condition and a rating of 5 indicates poor condition. Electrical equipment was given a code based on various potential issues/deficiencies, such as corrosion, evidence of overheating/arcing, grounding issues, etc. It should be noted that the ratings used in the conduct of the condition assessment evaluation are different than those utilized in the separate operations monitoring and performance evaluation report to assess risk failures of system processes, and therefore cannot be interchanged.

For equipment that is at or past its estimated useful life and/or has been given an overall condition rating of 3 or below, it is assumed that equipment must be replaced within the next 5 years if its condition deteriorates any further than today's condition. For equipment with between 5 and 10 years of remaining life and with an overall condition rating of 1 or 2, it is assumed that equipment must be replaced within the next 10 years. And for equipment with more than 10 years of remaining useful life and with a condition rating of 1 or 2, it is assumed that this equipment would need to be replaced within the next 20 years.

The condition of critical equipment at the WPAF is summarized in Table ES-1, below.

Table ES-1.
Critical Equipment Condition Summary

Facility and Equipment	Overall Condition	
East Shore WPAF- Primary Treatment		
Bar Screens	4	Fair to Poor
Grit Collectors	3	Fair
Grit Classifiers	3	Fair
Sewage Pumps #1, #3, #5	2	Good
Sewage Pumps #2, #4	2	Good
Primary Clarifiers	2	Good
Scrubber – Main Building	2	Good
Scrubber – RJ	3	Fair
Scrubber – X flow	3	Fair
Scrubber – Primary	2	Good
East Shore WPAF- Secondary Treatment		
Aeration Blowers	2	Good
Aeration Tanks	2	Good
Final Clarifiers	3	Fair
Hypochlorite Pumps	2	Good
Hypo Mixers	2	Good
Plant Water Pump #1	4	Fair to Poor
Plant Water Pumps #2, #3	2	Good
Plant Water Strainers	4	Fair to Poor
East Shore WPAF- Solids Handling/Disposal		
Gravity Belt Thickeners	3	Fair
TWAS Pumps	2	Good
TPS Pumps	2	Good
Gravity Thickener	3	Fair
Sludge Holding Tank	4	Fair to Poor
East Shore WPAF- Misc. Equipment		
Portable 6"Emergency Pump	3	Fair
Plant Generator	3	Fair
LARGE PUMP STATIONS		
East Street	3	Fair
Boulevard	3	Fair
SMALL PUMP STATIONS		
State & Union	4	Fair to Poor
Barnes Avenue		
Pumps	2	Good
Generator	2	Good
James Street Siphon		
Bar Screens	3	Fair

General facility upkeep is inconsistent across various areas of the WPAF. In general, heating, ventilating, and air conditioning (HVAC) systems in process areas are in poor condition, and in many cases, inoperable. Overall plant electrical distribution equipment is past the end of its useful life and should be replaced. There are a number of electrical code violations that should be corrected.

The assessment included four pump stations, previously selected by the Authority, and the James Street Siphon. The large pump stations, Boulevard and East Street, and the James Street Siphon, are in generally poor condition. While the pumps at both pump stations are in fair condition, the bar screens, grit removal, and gates at these facilities are well past their useful lives and in very poor condition. A complete upgrade of these two facilities is necessary and is included in the Authority's Capital Plan. The State & Union Pump Station is also well past its useful life, and plans are in the works to completely replace the station in a new location. Pirnie also visited the Barnes Avenue Pump Station. This station is relatively modern compared to the other stations, and is in good condition.

Recommendations

Based on our condition assessment and review of the Authority's current Capital Improvement Plan (CIP), we have the following recommendations for consideration by the Authority regarding capital improvement planning and critical equipment maintenance and facility integrity.

- A number of areas that were inspected are functionally past their useful lives and can no longer be effectively and efficiently maintained to meet their intended service. These facilities include:
    - East Shore WPAF headworks, including screening and grit collection systems.
    - East Street Pump Station.
    - Boulevard Pump Station.
    - State and Union Pump Station.

  The GNHWPCA has already developed a capital improvement program to address the above issues. The GNHWPCA, however, should consider accelerating plans for these facilities and implementing interim measures as needed to ensure sustained operations.

- Utilize information from assessment to make informed facilities management decisions. This includes a review of the estimated capital costs for the 5, 10, and 20 year replacement periods. Ensure that adequate capital funding is in place in these time horizons to complete required replacements/upgrades.

- Especially for those upgrades in the 5 year replacement period, complete more detailed studies/conceptual designs for replacement of these items taking into account cost/benefit of interim measures given budget constraints. Developing more informed and detailed cost estimates will allow the Authority to more accurately budget for these projects in their capital improvement plan (CIP).

- Immediately correct health and safety hazards. While not many were encountered during our inspections, there were some items noted as being health and safety issues.

- Complete data migration, clean-up, and quality checks for the Computerized Maintenance Management Systems (CMMS) to facilitate accurate scheduling and tracking of maintenance activities.

- Request that OMI review the maintenance contract requirements, and make critical adjustments to their current approach to maintaining the facilities.

- Maintain an ongoing inspection program to track the maintenance status of critical equipment.

- Continue to invest in ongoing maintenance and replacement of major equipment components for which a number of years of useful life are remaining, or for which the useful life can be extended by major overhauls/rebuilds of equipment. Improve maintenance programs on equipment and systems noted to be in fair to poor condition and not scheduled for near-term replacement.

1. Introduction

A condition assessment of the Critical Equipment Assets of the Greater New Haven Water Pollution Control Authority (the Authority or GNHWPCA) was conducted in September, 2011. The information developed as part of this assessment will serve to document the current condition of the major assets and serve as a basis for developing maintenance and capital improvement requirements moving forward.

Our approach to the project combined a physical condition assessment with interviews of Authority and Operations Management International (OMI) staff. OMI operates and maintains the treatment and collection facilities on behalf of the Authority pursuant to the terms and conditions of the Agreement between the two parties. The project also included a review and analysis of replacement costs for the critical assets to assist the Authority in prioritizing capital improvement requirements and preparing for the potential costs associated with such improvements.

The condition assessment began with site visits to the East Shore Water Pollution Abatement Facility (WPAF), Pump Stations and the James Street Siphon. Pirnie performed these site visits in September, 2011. This Condition Assessment Report (Report) presents a summary of the observations resulting from our field inspections along with order-of-magnitude budgetary cost estimates for those prioritized critical assets requiring repair or replacement.

Inspection Dates

Malcolm Pirnie (Pirnie) representatives conducted field inspections as follows:

- East Shore WPAF Review- Process Mechanical: September 14 and 15, 2011 by Seth Schneider
- Pump Stations Review- Process Mechanical: September 15 and 16, 2011 by Seth Schneider
- Pump Stations Review- Electrical and HVAC: September 19, 2011 by Scott Wingfield and Vincent Vitale
- East Shore WPAF Review- Electrical, HVAC and Structural : September 21, 2011 by Scott Wingfield, Vincent Vitale and Justin Minadeo

Authority representative Charlie Biggs accompanied Pirnie through the WPAF and through Electrical, HVAC and Structural inspections of the pump stations. OMI

representative Chris Smith accompanied Pirnie through portions of the process mechanical inspection of the WPAF and OMI representative Scott Carr accompanied Pirnie through the process mechanical inspection of the pump stations.

Report Organization

This Report is organized as follows:

- Section 1: Introduction
- Section 2: Assessment Approach
- Section 3: Condition Assessment. This section is organized by the items identified as critical equipment, in basic process order at the WPAF, starting from headworks and ending with solids handling and miscellaneous equipment. After critical equipment is discussed, condition of support systems (i.e., electrical, HVAC and structural is discussed). Finally, each pump station is described, first by process mechanical equipment and then by each of the support systems covered in our assessment.
- Section 4: Capital Improvement Program Impacts. This section presents order-of-magnitude estimates for replacement of critical equipment, organized by estimated replacement timeframe (i.e., next 5 years, next 10 years, or next 20 years).
- Section 5: Conclusions and Recommendations

Appendix A presents a summary list of the Critical Equipment Assets that were inspected, which includes the major equipment at the East Shore WPAF, the East Street, Boulevard, State and Union, and Barnes Avenue Pump Stations, and the James Street Siphon.

2. Assessment Approach

The assessment was performed by visiting each of the sites and visually inspecting equipment and structures. Included in the assessment were electrical, heating, ventilation, air conditioning, and structural evaluations. The assessment team consisted of Malcolm Pirnie senior design and operations specialists with process mechanical, electrical, HVAC and structural specialties, together with Authority and OMI staff. Team members visited the WPAF and pump stations selected by the Authority and conducted a qualitative assessment of critical equipment physical condition and functionality. The qualitative assessment consisted primarily of visual and sound observations. Authority and OMI staff who accompanied the assessment team were questioned about the equipment and their input was used to assess equipment maintenance history and reliability based on their experience and knowledge of the maintenance records.

A standardized inspection process including standard forms and conditional assessment ratings was used to conduct the assessment. A separate form was completed for each piece of equipment. Photographs of major pieces of equipment were taken during the inspection. A blank copy of the inspection forms used in this process and a key which describes the basis for condition assessment ratings is provided as Appendix B. In addition, completed copies of the forms, including photographs were scanned and copies onto a flash drive that is separately submitted to the Authority alone with the final copy of the Report.

Mechanical equipment was ranked on a scale of 1 to 5 for various criteria, such as corrosion, leakage, vibration, etc. Structures were also ranked on a scale of 1 to 5 for criteria including cracking, settling, delamination, etc. A rating of 1 indicates excellent condition and a rating of 5 indicates poor condition. Electrical equipment was given a code based on various potential issues/deficiencies, such as corrosion, evidence of overheating/arcing, grounding issues, etc. It should be noted that the ratings used in the conduct of the condition assessment evaluation are different than those utilized in the separate operations monitoring and performance evaluation report to assess risk failures of system processes, and therefore cannot be interchanged.

Based on the condition assessment findings a review of the potential repair and replacement requirements over the next 5, 10 and 20 years was conducted along with the identification of the potential magnitude of costs that may be required to implement improvements. The following constraints, however, dictated the approach to the assessment and the level of detail contained in the findings:

- Duration of inspections. Inspection durations were limited based on available budget. For process mechanical inspections, approximately one-and-a-half days

were utilized for inspections at the treatment plant and one day for inspections of the critical pump stations. Electrical and HVAC staff each had one day at the treatment plant and one day at the pump stations. The structural inspector had only one day at the treatment plant, and did not visit the pumping stations because a previous report on the pumping stations was known to be available.

- Equipment/Structures Assessed. Given the limits described above, only process mechanical equipment determined prior to the assessment to be critical equipment was evaluated. Electrical inspections were limited to main power feed and distribution equipment throughout the treatment plant and pump stations, and HVAC and structural inspections were focused on those areas defined by Authority staff to be most critical or problematic.

- Accessibility of Equipment/Structures. Some components and structures to be inspected were inaccessible due to their physical location or condition. For those equipment and structures that were not accessible, attempts were made to ascertain condition to the extent possible from the closest safe location. No attempts were made to employ ladders, harnesses, or other means of accessing locations that were otherwise inaccessible.

- Maintenance Information. A review of maintenance records was not performed as part of this assessment. Thus, it was not possible to determine if equipment condition for equipment that is not in good condition is a direct result of improper maintenance. Information on equipment maintenance used to complete the condition assessment forms is based on discussions with Authority and OMI staff. Further, information on major equipment overhauls or replacements is based on recollection of Authority and OMI staff, and thus the exact age of equipment is not necessarily accurate.

- Equipment not in Operation: When possible, the equipment was assessed during operation. However, much of the equipment operates intermittently and much of the equipment is redundant, so that it may only operate during peak flow events. Because inspections were not scheduled around peak flow events or around times when certain equipment operates, some information, such as noise and vibration levels was not possible to ascertain.

- Cost Estimates: As discussed further in Section 6, detailed take-offs and estimates for equipment replacement were not made. Estimates of replacement costs were primarily based on costs obtained from a 2003 asset valuation database with conceptual-level mark-ups and escalation factors to reflect current and future dollars The 2003 asset valuation database was compiled by American Appraisals, on behalf of the regional communities and was used as a basis for establishing the appraisal value of the system assets prior to regionalization.

3. Condition Assessment

This section discusses the results of the condition assessment performed at the East Shore WPAF and at the four pump stations and one siphon facility that were included in the scope of the assessment. The section is organized first by facility, with the pump stations following the treatment plant. For the treatment plant, this section is organized by treatment process, from headworks to solids handling facilities, starting with process mechanical items and then with electrical, HVAC and structural assessments. The pump stations are then organized by facility, with the observations of all disciplines provided together for each facility.

In addition to the physical inspections of equipment, the asset database, developed in 2003, was utilized to determine the installation date of each piece of equipment. Based on the installation date and our experience with such equipment and standard industry accepted practices, we assessed the remaining useful life of each piece of equipment. For equipment that is at or past its estimated useful life and/or has been given an overall condition rating of 3 or below, it is assumed that equipment must be replaced within the next 5 years if its condition deteriorates any further than today's condition. For equipment with between 5 and 10 years of remaining life and with an overall condition rating of 1 or 2, it is assumed that equipment must be replaced within the next 10 years. And for equipment with more than 10 years of remaining useful life and with a condition rating of 1 or 2, it is assumed that this equipment would need to be replaced within the next 20 years.

3.1. East Shore WPAF

3.1.1. Grit and Screening

Bar Screens No. 1 and 2 were installed in 1987, and while both were functional at the time of the inspection, the screens overall are in poor condition. Major observations are listed below:

- The Center Isolation Gate is missing from Bar Screen No. 1.
- Cotter pins are missing from the chains on both screens.
- Chain wear (on the north side) was observed for Bar Screen No. 1.
- The chain pins were found to be worn through on the links for Bar Screen No. 2.
- For Bar Screen No. 2, the bar rakes were not spaced evenly, and the chain was observed to twist as the rake pulls up.

- Both screens were observed to be significantly corroded, with extensive damage to the base and paint coat.
- Motors and controls were also found to be in mediocre to poor condition.

While both bar screens appear to be sized appropriately and are expected to satisfactorily meet demands and regulatory requirements,

Bar screens of this type are expected to have 25 years of useful life. Thus, the remaining useful life of both units was calculated to be 1 year. Thus, the equipment should be scheduled for replacement within the next 5 years.

Grit Collectors No. 1 through 4 were installed in 1987, and have been completely rebuilt within the last year. All units are functional, and all units overall are in moderate condition. Observations about the grit collectors are as follows:

- All four grit collectors appear to be sized appropriately and are expected to satisfactorily meet demands and regulatory requirements.
- Only minor corrosion and damage to the paint coat was observed.
- There were no observable issues with the motors regarding vibration or noise, although the motors are corroded significantly.
- Although the chains are relatively new, they appear visually to already be quite corroded. It is likely that the combination of the service at the atmosphere in the grit handling area is causing the chains to corrode prematurely.
- Significant damage to the outer grit collector housing and base were observed.

Given that the grit collector units were recently rebuilt, but the overall housing and motors are essentially at their useful lives, we estimate that the remaining useful life of the grit collectors is less than 10 years, and equipment should be completely replaced within that time.

Grit Classifiers No. 1 and 2 were also installed in 1987. The base for each unit was rebuilt around 2009. Observations on the condition of this equipment include the following:

- Both units appear to be sized appropriately and are expected to satisfactorily meet demands and regulatory requirements.
- The exteriors or both units were found to suffer from moderate corrosion.

- New screws were supplied for both units, but they have yet to be installed.
- The units are reported to require significant maintenance, likely as a result of their advanced age and the environmental conditions in this area.
- Water leaks from Grit Classifier No. 2 were presenting housekeeping issues and area maintenance item that should be addressed.
- No excessive vibration was observed, and the piping and valves were observed to be in reasonable condition.

It should be noted that it was not possible to inspect the motors on either unit. Given that the grit classifier units were recently rebuilt, but the overall housings are essentially at their useful lives, we estimate that the remaining useful life of the grit classifiers is less than 10 years, and equipment should be completely replaced within that time.

Although not on the critical equipment list, Authority staff indicated that the headworks inlet and outlet gates are an on-going source of concern. Thus, the condition of these assessed, as follows:

- The gates' condition was found to be generally poor.
- Significant to extreme corrosion was noted on all gates, with significant corrosion to supports and paint coating.
- All gates either experience substantial leakage or a complete seating failure. Sandbags must be used to try to minimize water leakage past closed gates.
- The bypass channel inlet and outlet gates are not functional, leading to the inability to effectively utilize the bypass channel.
- A ½-ton hoist used to lift gates and move equipment in the area is completely missing.
- Operators on all gates are in poor condition,
- Hydraulic tubing required to operate the main influent gate is completely missing.

The Inlet and Outlet Gates are not included in the 2003 asset inventory. However, these gates are believed to also date from 1987. Given their age and condition, we believe that these gates should be replaced within the next 5 years.

3.1.2. Main Sewage Pumps

Main Sewage Pumps No. 1 through 5 were inspected during the condition assessment. Main Sewage Pumps No. 1, 3, and 5 have 125 hp motors, while Main Sewage Pumps No. 2 and No. 4 have 250 hp motors. Although this information is missing from the 2003 asset inventory, it is believed that the main sewage pumps were originally installed in the 1980s. All four of the main sewage pumps were rebuilt in 2004 and all motors were replaced at this time. We determined the main sewage pumps to be in overall good condition. Observations are as follows:

- The VFDs for all the main sewage pumps appear to be in excellent condition and well maintained, however, Main Sewage Pump No. 1 was out of service due to a VFD fault.

- Only pumps No. 3 and 5 were in service during our visit. Thus, only these pumps could be analyzed for vibration and seal leakage.

- A moderate level of corrosion was observed on Main Sewage Pump No. 1, with moderate damage to the paint coat. The base was found to be in overall good condition.

- Main Sewage Pump No. 2 was found to have less corrosion than Main Sewage Pump No. 1, and the paint was in better overall condition. Main Sewage Pump No. 3 was in service during our visit. While the level of vibration from the motor was excellent, a moderate amount of leakage was observed from the seals. The corrosion and damage to the paint coat for Main Sewage Pump No. 3 was observed to be moderate. The condition of Main Sewage Pump No. 4 was similar to the condition of Main Sewage Pump No. 3. A moderate amount of corrosion was noted, with damage to the paint coat. The corrosion appeared more extensive around the base and piping. Main Sewage Pump No. 5 suffers from a fair to moderate amount of corrosion and damage to the paint coat, although this corrosion appears to be on the surface only. The base suffers from more severe corrosion. Main sewage Pump No. 5 was in service during our visit and minor leakage was observed from the seals, similar to Main Sewage Pump No. 3., and the performance of the motor was considered excellent with no abnormal vibration.

- Generally, all associated piping, valves, instruments and controls were found to be in generally good condition.

Because all of the main sewage pumps were found to be in generally good condition and have been recently re-built, it is not anticipated that replacement would be required within 10 years. However, replacement will be necessary within the next 20 years.

3.1.3. Primary Clarifiers

Primary Clarifiers No. 1 and 2 were installed in 1975 and No. 3 was installed in 1994. Because the tanks are completely covered, access for inspection was limited. However, the chains were inspected through access hatches. The following observations were made about Primary Clarifiers No. 1 and 2:

- The chains were found to be in very good condition, showing only normal aging.
- The walkways were in good condition, with only minor vegetative growth and occasional minor spalling.
- Tank covers were in good condition, showing only normal wear.
- Only typical vibration and noise from the motors was detected, and the paint and coating lacked all but minor corrosion.
- The skimmers were not functioning on either primary clarifier.
- The flights, paddles, and chains had been replaced recently. The drive chain had also recently been replaced and tensioned.
- The motor for Primary Clarifier No. 1 was rusted.
- Local control panels were in excellent condition. The overall condition of the two clarifiers was good, and it is not anticipated that replacement would be required within 10 years.

The overall condition of Clarifier No. 3 is poor. The clarifier is presently out of service, and has been for quite some time. However, parts for repair are reported to be available and according to OMI personnel, work is expected to begin shortly. The following observations were made:

- The chain was found to be substantially rusted from the view through the access hatches.
- The tank covers were in good condition, showing only typical wear.
- The motors were in good condition, and the controls were in excellent shape.

Given that no major structural issues have been reported or were evident on any of the clarifiers, and the fact that when equipment in Clarifier No. 3 is replaced, all three tanks will have relatively new equipment, we do not believe that replacement of clarifier equipment or any major structural work will be required in the next 10 years. However,

within 20 years, major equipment will once again need to be replaced and the structure will likely need to be upgraded/repaired.

3.1.4. Activated Sludge Process

Aeration Blowers No. 1 through No. 5 were inspected. Blowers No. 1, No. 4, and No. 5 are larger units, with a 700hp motor and a capacity of approximately 11,300scfm. Blowers No. 2 and No. 3 are smaller, with 400hp motors and 4,000scfm. All the aeration blowers appeared to be in very good condition. The aeration blower and motors were installed and rebuilt at different times within the last few years, but all blower controls date to 1999.

Aeration Blower No. 1 was installed in 1994, and the motor was rebuilt in 2008. The following observations were made for this blower:

- Aeration Blower No. 1 was not in service, so it could not be inspected for leaks or vibration.
- However, vibration from the bearings was reported to be an issue.
- Some superficial corrosion on the base was observed, but otherwise, the paint coat was in excellent condition.
- The shaft has rusted, and is missing a guard.
- The piping, valves, instrumentation and controls all appeared to be in excellent condition, except that the expansion joints appeared somewhat worn and bolts had rusted.

Aeration Blowers No. 2 and No. 3 were installed in 2008. Both blowers were not in service, and thus could not be inspected for vibration or leakage. The blowers are new and in excellent condition.

- No corrosion, damage to the base, or damage to the paint coat was observed, with the exception that an unusually large amount of paint was found to have peeled from the motor housing of Blower No. 2, especially considering its age.
- The shafts had some rust, but the guards were in place.
- Some rusting was observed on the piping and valves, but these are otherwise in good condition.

- The piping, valves, instrumentation, and controls all appear to be in excellent condition. However, it is reported that a loud air leak emanates from either the check or discharge butterfly valve for Blower No. 3.

- It is estimated that the bearings will likely need to be replaced in 4 to 5 years for both blowers.

Aeration Blowers No. 4 and 5, and their associated motors, were recently rebuilt in 2006. Both blowers were in service.

- No undue vibration was observed, nor was any leakage found from the blowers or the associated aeration piping and valves.

- Some minor corrosion was observed

- The blowers should be re-painted in the near future.

- Minor corrosion was also observed on the bases.

- The piping, valves, instrumentation and controls were observed to be in excellent condition, although some rust was noted on the piping and valves associated with each blower.

The process air header piping was replaced in 1994, and is generally in good condition. However, there are leaks from the process air piping, which is typical for this type of system. These leaks should be addressed.

Because all of the aeration blowers were found to be in generally good condition, it is not anticipated that replacement would be required within 10 years. Significant upgrades should be planned within 20 years, however.

Aeration Tanks No. 1 through 4 were installed in 1975. The aeration tanks are collectively in good condition. The following observations were made:

- The concrete in all the tanks appears to be in good condition.

- The walkways have undergone some deterioration and need some minor repairs.

- The gate operators are in poor condition, which is typical of outdoor installations.

- There are a number of air leaks in droplegs and in diffuser piping which need to be addressed.

- The aeration tank equipment is fairly reliable, and does not pose an excessive operations and maintenance burden on the facility.

- The tanks have good capacity and can satisfy regulatory requirements.

Because all of the aeration tanks were found to be in generally good condition, it is not anticipated that major repairs to the tanks themselves would be required within 10 years. However, it is likely that air droplegs and diffusers will require replacement within the 10 year timeframe. Structural repairs to the tanks and other major repairs/replacements (such as gates) should be planned within the next 20 years.

3.1.5. Secondary Clarifiers

Final Clarifiers No. 1 through No. 8 were installed in 1974, and retrofitted in 1994. All clarifiers were collectively found to be in moderate condition. The following observations were made:

- The clarifiers were found to be fairly reliable, imposing a moderate operations and maintenance burden.
- The clarifiers meet capacity and regulatory demands.
- Moderate surface corrosion was observed on all clarifiers. The corrosion did not appear to be structural. The exception was for Final Clarifiers No. 5 and 7, which were found to be more corroded than the others. For Final Clarifier No. 5, the corrosion was observed to be mostly on the middle portion of the baffle.
- The walkway supports for Final Clarifier No. 1 corroded and significant movement of that walkway was noted while walking on it.
- Final Clarifier No. 6 also exhibits more corrosion than typical, with vegetation growing on supports.
- No groundwater leakage was visually observed into the clarifiers although such leakage might not be able to be assessed visually.
- Some concrete discoloration was noted for all the clarifiers, along with minor spalling above the water surface.
- The paint coating was in moderate condition for all the clarifiers, showing some deterioration.
- The drive motors were also in moderate condition, and the condition varied between clarifiers. The motor for Final Clarifier No. 2 appeared to be in the worst condition, showing significant deterioration.

- Some clarifier weir segments have been replaced with blanking plates to ensure a more even distribution of flow. These blanking plates are coming off, and should be replaced.

- For the instrumentation and control, all sludge blanket detectors are out of service and require replacement.

Given the age of the clarifier structures, inspections should be planned for the near future, and significant upgrades should be assumed necessary within the next 10 years. Further, all mechanical equipment should be considered for upgrade within the next 10 years.

3.1.6. Disinfection System

Hypochlorite Metering Pumps No. 1 through No. 4 were installed in 2009. The metering pumps are all 1 hp, and are all in good condition. The following observations were made:

- All four pumps showed some minor corrosion. This is notable, due to the recent installation of the pumps and is likely a result of the poor atmospheric conditions in the area and the nature of the chemical being handled.

- Moderate corrosion and deposits were noted on the base, supports and chemical containment area for all pumps. Most of these items were not upgraded or replaced when the pumps were replaced, and as such, have been subject to a much longer duration of wear than the pumps. Such corrosion is typical for this type of service and for the age of the bases, supports and containment.

- The housekeeping in the area was poor. Significant amounts of standing water were observed, and all paint in the area needs to be redone.

- No undue vibration or noise was observed from the operating metering pumps. Metering Pumps No. 2 and No. 4 were not in service, and thus could not be analyzed for excessive vibration or noise.

- The pumps were found to be reliable and pose only a routine operations and maintenance burden on the facility.

- The pumps are reported to have sufficient capacity and can meet all regulatory requirements for treatment.

- The instrumentation, valves, and controls were found to be in good condition.

Because the hypochlorite metering pumps were found to be in generally good condition and are relatively new, it is not anticipated that replacement would be required in the near-term. Thus, replacement should be planned for the 20 year horizon.

Hypochlorite Mixing Pumps No. 1 and 2 were investigated. The mixing pumps are submersible, so a third pump that had been removed from service (but is supposedly rotated into service with the other two) was used for nameplate information and as a surrogate for the other pumps to assess condition. The mixing pumps were installed in 2004 and are all 2.5 hp.

- The pumps were all found to be in good working order, although it was found that the third, spare pump did not appear to have been rotated into service as often as is OMI's standard operating procedure.
- The pumps were all found to be reliable, and impose only a moderate operations and maintenance burden on the facility.
- The spare pump showed no sign of corrosion or damage to the paint coat.
- The mixing pumps are reported to have sufficient capacity and meet all regulatory requirements.
- There is a significant buildup of floatables in the channel leading to the Chlorine Contact Tanks that currently poses a housekeeping issue but could eventually lead to solids carryover into the Chlorine Contact Tanks, jeopardizing permit compliance.

Because the hypochlorite mixing pumps were found to be in generally good condition and are relatively new, it is not anticipated that replacement would be required in the near-term. Thus, replacement should be planned for the 20 year horizon.

Plant Water Pumps No. 1 through No. 3 were inspected, and were found to be in very different conditions. Plant Water Pumps No. 1 and No. 2 are 100 hp, and Plant Water Pump No. 3 is 75hp. All three pumps are VFD controlled. The capacity of all three pumps is sufficient, and the pumps are expected to meet all regulatory requirements. Two of the three pumps are always in service, and these pumps are critical for incineration. The internals of all three pumps were rebuilt in 2011.

Plant Water Pump No. 1 was installed in 1995, and is in poor overall condition.

- The surface of the pump is completely corroded, and the volute appears close to failure. The support and base of the pump is also very badly corroded, with the steel being more corroded than the concrete. The paint coat on the pump has been corroded away.

- The motor is in fair condition.
- The piping and valves associated with the Plant Water Pump No. 1 are also in poor condition due to corrosion. However, the main header is in good condition.
- There are no local controls associated with the pump. The local pressure gauge is no longer readable.
- The pump does leak slightly. The pump also moderately vibrates, although no damage from vibration could be observed.

Plant Water Pump No. 2 was installed around 2009, and is in overall good condition.

- There is moderate corrosion of the surface of the pump, although the pump appears to be structurally sound. There is also a moderate amount of corrosion to the base of the pump. There is a moderate degree of damage to the paint coat.
- The pump vibrates minimally and no leakage was observed.
- The associated piping and valves are in fair condition.
- There are no local controls associated with the pump. The pressure gauge for the pump is missing.

Plant Water Pump No. 3 was installed in 2010, and also is in overall good condition. Plant Water Pump No. 3 was not in service, so it could not be examined for vibration and leakage.

- The pump showed almost no signs of corrosion. The base, however, showed moderate signs of corrosion and the concrete was deteriorating. The base paint coat on the base needs to be repaired.
- There was minor surface corrosion to the associated piping and valves.
- There are no local controls associated with the pump. The pressure gauge is in good condition.

Because Plant Water Pumps No. 2 and 3 were found to be in generally good condition, it is not anticipated that major repairs to the pumps would be required within 10 years. Thus, a 20 year replacement timeframe is used for these pumps. However, Plant Water Pump No. 1 was found to be in poor condition. Considering the critical need for these pumps and the fact that there is only one standby, replacement for Plant Water Pump No. 1 should be scheduled in the next 5 years.

Plant Water Strainers No. 1 through No. 3 were investigated. All three strainers have a 1/3hp motor and were installed around 2009. Two of the three strainers were in service at the time of inspection. The following observations were made about the strainers:

- All three strainers are reported to be fairly reliable and a low operations and maintenance burden when in service. All three strainers sufficiently satisfy all regulatory requirements.
- Plant Water Strainers No. 1 and No. 2 were out of service. The strainers had been damaged during a recent storm. However, this storm was anomalous and the strainers can generally function in their intended duty.
- The strainer basket for Plant Water Strainer No. 1 was very corroded and damaged. The strainer basket for the other strainers was in good condition.
- The associated support piping was in fair condition, but suffered from some surface corrosion. There was also some pocking of the paint coatings.
- The motor, instrumentation, and controls were new, and in excellent condition.
- Plant Water Strainer No. 1, the only operating strainer, showed no signs of leakage. The strainer is loud, but this was reported to be normal.

Because Plant Water Strainer No. 3 was found to be in generally good condition, it is not anticipated that major repairs to the strainers would be required within 10 years. Thus, a 20 year replacement timeframe is assumed for the strainers. However, Plant Water Strainers No. 2 and No. 3 suffered damage during a recent storm, and required immediate repair.

3.1.7. Odor Control

There are four wet scrubber systems that provide odor control for the critical areas of the WPAF which were inspected.

The AMBI Scrubber was installed around 1993. This scrubber provides odor control for the main building, which includes the sludge holding tank, gravity thickeners, the main sewage pump wet well and the thickened waste activated sludge (TWAS) tanks. The fan size for this scrubber is 40hp. This system is also referred to as the "Ambient" or "Main Building" scrubber. The AMBI Scrubber was found to be in overall good condition. The following observations were made:

- There is moderate corrosion of the unit, although the areas covered by paint are in excellent condition. There was also a moderate amount of corrosion to the base and supports.

- The piping and valves were in good condition as well as the instruments.
- The motors were found to be corroded.
- The scrubber is fairly reliable and imposes only a minor operations and maintenance burden.
- The scrubber has sufficient capacity for process and regulatory requirements.

The RJ Scrubber was installed around 1996. This scrubber provides odor control for the inlet works area beneath the covers of the grit channels and the lower levels of the bar screen channels. The RJ Scrubber has a capacity of 5,000 lbs. The RJ Scrubber was investigated, and found to be in overall moderate condition. The following observations were made:

- The scrubber suffers from moderate corrosion and deterioration to the base and supports.
- The paint coat on the scrubber was in good condition, but some insulation is coming off.
- The ductwork to the scrubber has some minor leaks.
- The fan motor exhibits moderate vibration.
- The piping and valves were in moderate condition. The instruments and local control panel were in good condition. New controls had been recently installed.
- The scrubber is fairly reliable and poses a low operations and maintenance burden on the plant. There is sufficient capacity for process and regulatory requirements.

The X-Flow Scrubber was installed around 1987. This scrubber provides odor control for the air space above the grit tank covers and the building space above the bar screen channels. The X-Flow Scrubber was investigated, and found to be in overall moderate condition. The following observations were made:

- Some corrosion was noted, with moderate damage to the base and supports, and moderate damage to the paint coat.
- No leakage was observed.
- The fan unit exhibited some vibration and noise, and is in need of replacement.
- The piping and valves were in moderate condition. The instrumentation was in good condition.

- The scrubber is fairly reliable and poses a low operations and maintenance burden on the plant. There is sufficient capacity for process and regulatory requirements.

The Paramount Scrubber was installed around 1997. This scrubber system provides odor control for the primary clarifiers, including skimmings, and consists of two scrubber units. The scrubber has a 40,000 cfm capacity, and runs as two units in parallel. All couplings were recently replaced and the expansion joints were replaced two years ago. The Paramount Skimmer was found to be in overall good condition. The following observations were made:

- The scrubber units were in very good condition. No leaks were observed, and there was only minimal evidence of corrosion and corrosive damage to the paint.
- Insulation was falling off, and the units should be repainted.
- The base and supports for the fans were moderately corroded. The fan housings were somewhat rusted.
- The fans were noisy, but there was no excessive vibration.
- The piping and valves are in good condition, especially considering the unit is located outdoors.
- The scrubber is fairly reliable but poses a moderate operations and maintenance burden on the plant. There is sufficient capacity for process and regulatory requirements.

Each of the scrubbers is nearing its useful life. However, the scrubbers are all in generally good condition. Given the age and condition of each of the scrubbers, significant upgrades should be planned within the next 10 years.

The Chemical Feed System supplies all four scrubbers, and consists of several components, including:

- The five Sodium Hydroxide Pumps No. 1 through No. 5, the Sodium Hydroxide Transfer Pumps, and the two Sodium Hydroxide Storage Tanks.
- The Sulfuric Acid Pump and Sulfuric Acid Storage Tank.
- The Sodium Hypochlorite Pumps No. 1 and No. 2 and the Sodium Hypochlorite Storage Tanks No. 1 and No. 2.

The Chemical Feed System was inspected and found to be in overall good condition. The following observations were made:

- The sodium hydroxide pumps were in moderate condition. A moderate degree of corrosive damage to the paint coat and support bases was observed.
- The sulfuric acid pumps were also in moderate condition, with some corrosive damage to the base supports. These pumps had recently been repainted.
- The sodium hypochlorite pumps were found to be in overall good condition.
- The bulk storage tanks were found to be in good condition based on an external inspection only.
- The Chemical Feed System is reported to be fairly reliable and a low operations and maintenance burden.
- The capacity of the Chemical Feed system is sufficient for process and regulatory demands.

Because the Chemical Feed System was found to be in generally good condition, it is not anticipated that replacement would be required within 10 years. However, significant upgrades to components should be planned within 20 years.

3.1.8. Solids Handling

Gravity Belt Thickeners No. 1 and 2 were installed around 1984, and were found to be in overall moderate condition. Both units are reported to have sufficient capacity and meet all regulatory needs. Neither unit was in service at the time of inspection, so the units could not be inspected for vibration or leakage. The following observations were made:

- Both units suffered from moderate corrosion, but it appeared to be superficial. The paint coat was in poor condition. Both units require cleaning and new paint. The support and base was also corroded.
- The associated piping and valves for both units were in moderate condition.
- The piping, valves, instrumentation and controls for both units were in poor condition.
- Both units present a serious housekeeping issue with free drainage of water, but are otherwise reliable and do not impose a significant operations and maintenance burden on the facility.

Given the age of the thickeners, inspections should be planned for the near future, and both units should be considered for upgrade/replacement within the next 10 years.

Thickened Waste Activated Sludge (TWAS) Pumps No. 1 and No. 2 were investigated. Both pumps are 10 hp and were installed around 2007. Neither pump was in service, so they could not be investigated for noise and vibration, and the piping and seals could not be inspected for leaks. The following observations were made:

- The surface of the pumps appears moderately corroded, which is significant for their age and is likely a result of poor atmospheric conditions. Only minor damage was observed to the paint coat.
- The support and base appeared to be in moderate condition.
- The piping, valves, instrumentation, and controls all appeared to be good condition.
- The pumps are reported to be reasonably reliable and not pose an excessive operations and maintenance burden on the facility.
- The pumps are sized to meet all process and regulatory demands.

Because both pumps were found to be in generally good condition, it is not anticipated that major repairs to the pumps would be required within 10 years. Thus, a 20 year replacement timeframe is used.

Thickened Primary Sludge Pumps No. 1 and No. 2 were investigated. Both pumps were installed around 2006, and have 15 hp motors. Only Thickened Primary Sludge Pump No. 1 was operating. The following observations were made:

- The surfaces of both pumps suffered a moderate amount of corrosion, with Sludge Pump No. 2 suffering more corrosion than Sludge Pump No. 1. The level of corrosion is significant because of the age of the pumps.
- No leaks from the seals or piping of Sludge Pump No. 1 were observed. Sludge Pump No. 2 was offline.
- The motor for Sludge Pumps No. 1 was found to be relatively noisy.
- The bases and supports for both pumps were very corroded, and the damage to the paint coats on both was significant.
- The piping, valves, and instrumentation for both pumps was in poor condition. There are no local controls.

- There is poor ventilation in the area of the sludge pumps. The entire area is in need of housekeeping, painting and improved ventilation.

- Both pumps impose a high operations and maintenance burden on the facility, although when operating, are said to be fairly reliable. Sludge Pumps No. 1 needed to be rebuilt after operating for only three years.

- Both pumps are reported to have sufficient capacity to meet process and regulatory requirements.

Given the age of the pumps, inspections should be planned for the near future, and both units will require maintenance within the next 10 years. However, complete replacement should be planned for the next 20 years.

The Gravity Thickener was investigated. The Gravity Thickener was constructed around 1975 and the mechanical drive was replaced around 1985. The overall condition of the Gravity Thickener was moderate, and the following observations were made:

- It was not possible to inspect the interior of the unit for corrosion, as the unit was in service, and inspection can only be conducted through hatches.

- No leakage was observed, although given the limited ability to inspect, leakage may not be able to be observed.

- The drive motor exhibited some vibration, but the vibration was not excessive. The motor was otherwise in poor condition, and appeared as if replacement would be needed soon.

- From what limited portions of the unit could be observed, the paint and coating was in reasonable condition.

- The facility has only one thickener. While the capacity of the thickener is sufficient, there is no redundancy.

- The thickener is fairly reliable and does not impose an excessive operations and maintenance burden.

Given the age of the thickener structure and a lack of redundancy, inspections should be planned for the near future, and significant upgrades should be assumed necessary within the next 10 years. Further, all mechanical equipment should be considered for replacement within the next 10 years.

The Sludge Holding Tank was installed in 1975. The overall condition of the storage tank was poor, and the following observations were made:

- The agitation units were reported to be fairly reliable, although one was out of service at the time of inspection.
- The structure was in poor condition. Damage was noted to the support and base. Damage to the paint coating was also noted.
- The roof of the storage tank is structurally deficient.
- The capacity of the unit is sufficient for process and regulatory needs.
- The storage tank is a moderate maintenance burden on the facility, and the storage tank as a whole in only moderately reliable.

Given the age of the holding tank structure, inspections should be planned for the near future, and significant upgrades should be assumed necessary within the next 5 years. Further, all mechanical equipment should be considered for upgrade within the next 5 years.

3.1.9. Backup Equipment

The 6 in. portable pump was inspected, and found to be in moderate condition. The pump has a capacity of 1.5 MGD, and was not in service at the time of inspection. The following observations were made:

- The pump suffers from a moderate amount of corrosion, and the support base is also moderately corroded. Damage to the paint coat was noted.
- The pump was reported to be very reliable until recently, when it went out of service, reportedly due to a dead battery. The pump was reported to have worked for the duration of a recent flood.

Given the condition of the pump, inspections should be planned for the near future, and the unit should be considered for replacement within the next 10 years.

The Emergency Generator was installed in 1975. The unit has a capacity of 300 kW and is in moderate condition. The unit was not in service at the time of inspection. The following observations were made:

- The unit is corroded, but the corrosion appears superficial. Moderate damage to the base support and paint coat was noted. The diesel fuel storage tank appears to be in good condition.

- Associated piping and valves were in moderate condition.

- The backup generator is reported to be very reliable and a minimal operations and maintenance burden on the facility.

- The backup generator is not sufficiently sized for the plant. Portable units must also be used during power outage.

Given the condition of the generator and the lack of capacity, the unit should be considered for upgrade within the next 5 years.

3.1.10. HVAC

The HVAC Equipment in the Boiler Room of the Administration Building was inspected. The following observations were made:

- The two Boilers are in good condition, although insulation on piping and valves needs repair.

- The Condensate Recirculation Pumps No. 1 and No. 2 appear to be in moderate condition. The local control panel is in good condition. The pumps are reliable and pose a low operations and maintenance burden.

- Hot Water Circulation Pumps No. 1 and No. 2 have moderate corrosive damage and damage to the base and support. The units have moderate damage to the paint coat. No leaks were observed. The piping, valves, and instrumentation appear to be in moderate condition. The pumps are reportedly reliable and pose a low operations and maintenance burden.

- The Pump for Heat Exchanger 1 has moderate corrosive damage, but does not leak. Only minor damage to the support and base was observed. However, there was moderate damage to the paint coat. The piping, valves, and motor are in good condition. The pump is reportedly reliable and poses a low operations and maintenance burden. There are no other reported problems.

- The controls are reportedly reliable and pose a low operations and maintenance burden. There are no other reported problems.

Due to the generally favorable condition of the HVAC Equipment in the Boiler Room and its age, it is recommended that all units be inspected and considered for replacement within 10 years.

Additional HVAC Equipment within the Administration Building and on the roof of the Administration Building was inspected. The equipment was found to be overall in poor condition. The following observations were made:

- Most Exhaust Fans were inoperable. All units suffered from moderate to severe corrosion. Two units were severely corroded.

- The four Condensation Units AH-1, AH-3, AH-4, and AH-5 were all moderately to very corroded. The units all suffer moderate to significant damage to the base and supports. The piping, valves, and instruments are in poor condition. The ductwork is in moderate condition for all units. Two Condensation units' AH-1 and AH-3 are inoperable.

Due to the poor condition of the Exhaust Fans on the roof of the Administration Building and the poor condition of the Air handling Units, these units should be replaced as soon as possible.

The HVAC Equipment in the Main Load Center, Electrical Room of the Administration Building, Substation No. 2, and Substation No. 3 was inspected. The following observations were made:

- The two Exhaust Fans No. 1 and No. 2 in the Main Load Center suffer only a modest amount of corrosion. The paint coat is in good condition. No damage to the supports was observed. The piping, valves, motor, and local controls have suffered some damage. The fans are reportedly reliable and pose a low operations and maintenance burden, but only one fan was operating. Both fans should have been in service.

- The two Exhaust Fans No. 1 and No. 2 in the Electrical Room in the Administration Building have only a modest amount of corrosion. The paint coat is in good condition. No damage to the supports was observed. The piping, valves, motor, and local controls have suffered some damage. The fans are reportedly only moderately reliable and pose a greater operations and maintenance burden than desirable. Only one fan was operating during our inspection. Both fans should have been in service.

- There is no significant corrosion to the Air Conditioning Unit in the Electrical Room. The paint coat is in excellent condition. A moderate amount of damage to the supports was observed. The piping, valves, motor, and local controls are in excellent condition. The fans are reportedly reliable and pose a low operations and maintenance burden.

- The two Exhaust Fans in Sub Station No. 2 were inspected to be found in poor condition. The units were not found to be operable, and should be replaced immediately.

- The HVAC Equipment in Substation No. 3 was inspected and found to be poor condition. Many units were inoperable. Units that were operating were found to be corroded and in poor condition.

The HVAC Equipment in the Chemical Room of the Administration Building was inspected. The following observations were made:

- The three Air Handling Units were inspected and found to be in generally poor condition. The units are very corroded with extreme corrosion of the base and supports, which poses a safety concern. The paint coat is severely damaged. The ductwork and instruments are in poor condition. The fans are reportedly inoperable. There is no heating and ventilation in the area.

- The Condensation Unit AH-2, however, is new and in excellent condition.

Due to the level of corrosion, the safety concerns, and the fact that the units are inoperable, the air handling units in the Chemical Area of the Administration Building should be replaced immediately.

The HVAC Equipment in the Maintenance Building and Maintenance Garage was inspected. The following observations were made:

- The Air Handling Unit and Fan for the Maintenance Building was inspected and found to be in poor overall condition. The unit is operable but unreliable and poses an operations and maintenance burden for the facility.

- The three Exhaust Fans in the Maintenance Garage were found to be inoperable.

Due to the poor condition of the equipment in the Maintenance Building and Maintenance Garage, the air handling units and exhaust fans should be replaced immediately.

The HVAC Equipment in the Inlet Works Building was inspected. The following observations were made:

- The Air Handling Unit is in good overall condition and functional.
- The Exhaust Fans on the roof were in poor condition. One unit was inoperable.

The Air Handling Unit is expected to require replacement within 10 years. The Exhaust Fans should be inspected and replaced immediately.

The HVAC Equipment in the Scrubber Pump Room was inspected. The following observations were made:

- The Air Handling Unit is in poor condition and is inoperable. There is significant corrosion to the base and support.
- The exhaust fans in the Chemical Room were found to be in overall good to excellent condition.

The Air Handling Unit should be inspected and replaced immediately. The Exhaust Fans are expected to require replacement within 10 years.

3.1.11. Electrical

The Electrical Equipment in the Administration Building was inspected. All electrical equipment in the Administration Building was installed in 1976. The following observations were made:

- MCCs M-2, M-3, M-4, M-6, M-7 M-8, and M-11 were inspected. For all MCCs, arc flash and maintenance labels were missing. There was no indication of recent testing. The age and location of the MCCs is an issue, as these units are nearing the end of their useful lives. MCC M-2 is located in a storage room and access is obstructed. MCC M-3, M-4, and M-7 have water pipes overhead which is a code violation. MCC M-3 was not in service. MCC M-11 is located in the basement and subject to flooding. MCC M-2 and M-8 experience nuisance tripping. MCC M-3 and M-4 have minor corrosion.
- Panel Boards EG-1, EG-2, EG-3, LPB & PPB, and LPD & PPD were inspected. For all panel boards, corrosion and nuisance tripping was an issue. An HVAC duct bank is located above Panel Board LPB & PBB. Flammable material is stored in front of Panel Board LPB & PBB. These items are code violations.
- The Switchboard was inspected. The Switchboard is located in the basement and is operational. Major electrical equipment in below-grade areas of the plant

presents a potential flooding concern. In future upgrades, this equipment should be moved to higher elevations.

- The 13.8 kV Switchgear was inspected. The switchgear experiences nuisance tripping, and is located in the basement. Some surface corrosion was inspected.

- The 480 V Switchgear was inspected. The switchgear shows some surface corrosion around the floor. The switchgear is located in the basement and there are clearance issues which are code violations.

The electrical equipment in the Administration Building is, for the most part, functional. However, the location is poor, and considering the age of the equipment, replacement and relocation should be planned for within 10 years.

The Electrical Equipment in the Inlet Works Building was inspected. The following observations were made:

- The outdoor Substation was found to be in good condition.

- The Panel Boards, despite missing a door, were in good condition.

- MCC PW and MCC PW-2 were found to be in good condition.

Based upon the good condition of the electrical equipment in the Inlet Works Building, replacement is not anticipated within 10 years.

The Electrical Equipment in Substation No. 2 was inspected. All equipment was installed in 1976. The following observations were made:

- The 13.8 kV and 4.16 kV Switchgear were in decent condition, except for the age.

- MCCs A-5 and A-6 were found to be in good condition. Some surface corrosion was observed. Clearance is a code violation. For both MCCs arc flash and maintenance labels were missing. There was no indication of recent testing.

- Panel Boards SLP-B and LP-A were found to be in decent condition except for some surface corrosion.

The electrical equipment in Substation No. 2 is functional, but considering the age of the equipment, replacement should be planned for within 10 years.

The Electrical Equipment in Substation No. 3 was inspected. All equipment was installed in 1976. The following observations were made:

- The 13.8 kV and 4.16 kV Switchgear were in decent condition for their age.

- MCCs S-3 and S-4 were found to be in good condition. Some surface corrosion was observed. For both MCCs arc flash and maintenance labels were missing. There was no indication of recent testing.

- Panel Boards MDP A-5, P1, A5-1A, and A5-1 were found to be in decent condition except for some surface corrosion.

The electrical equipment in Substation No. 3 is functional, but considering the age of the equipment, replacement should be planned for within 10 years.

3.1.12. **Structural**

The structural conditions of buildings at the East Shore WPAF were assessed. All buildings were found to be in excellent structural condition with the exception of the Garage which was in good condition. However, the sludge holding tank is reported to be in very poor condition, but could not be accessed for inspection due to safety concerns. The following observations were made:

- Only minor cracking at the exterior stair and in the basement ceiling above the hot water heater in the Maintenance Building were observed.

- Some leakage in the Tunnel was observed at the intersection between the tanks and the basement wall.

- Only minor loss of mortar in exterior bricks of Generator Building was observed.

- The Inlet Works Building suffered some damaged architectural panels, a diagonal crack in the bottom course of brick, and some damaged brick.

- The Inlet Works Building Overhead Doors require re-painting. Corrosion of pipe supports to the Odor Control unit and around the skylight was noted. There was exposed repair spalling in the floor of the Scrubber Recirculation Pump Room and cracks in the corner of the basement roof.

- The Gravity Thickener brick needs re-pointing. A vertical crack in the brick and minor corrosion of cross beams were noted. Small cracks in the coping were observed.

- The Holding Tank was fenced off reportedly because the underside of the slab is deteriorated. There is some loss of joint sealant in the top slab for the Holding Tanks.

- The Abandoned Thickener exhibits some cracks and spall in the coping. There were some loose bricks, and brick needs re-pointing. Brick on the building needs re-pointing.

- The garage is missing brick and missing mortar at the top of the doors. Minor damage to the overhead doors was observed. There was a vertical crack in the interior block. There were moderate cracks in the floor and damage to the interior brick. Some damage was noted to the back of the building and re-pointing is required.

- The Administration Building has some damaged block around the opening in the upper level. A crack around the opening was observed. There is peeling paint and staining by the back stairs. Exposed repair and cracks in the brick were found in the back corner.

- The Primary Tanks had some vegetative growth in cracks and joints. There is exposed vertical rebar in the front right corner. There is minor cracking at the outside face of the back wall. There is a severe crack adjacent to the expansion joint in the back wall. The metal stair in the back, left corer has no support at the bottom. There were small cracks in the secondary walkway slab. Some handrails were missing.

- There was a crack in the loading dock of the Sludge Pump Station. Sealant has cracked. There is a crack in the block above the restroom and spall in the exterior wall.

- There are minor cracks in the center walkway of the Secondary Clarifiers. A water stop was not placed correctly in the wall. There is a crack in the wall, near the stairs. There was a crack in the exterior wall. The wall adjacent to the storage area is cracked and leaning. Expansion joint sealing is failing.

- The Chlorine Contact Tanks have a vertical crack in between each expansion joint and spalling at the top of the exterior walls.

- The Aeration Tanks have failed expansion joint sealant in the walkways and cracks in the center walkways. There are small cracks in the exterior walls and some exposed rebar. There is a notable crack in the stair landing and.

Because the structural conditions of the buildings at the East Shore WPAF were found to be in excellent to good condition, replacement of the structures is not expected within 25 years. However, inspections should be conducted as soon as possible and minor repairs should be made.

3.2. Pump Stations

3.2.1. East Street Pump Station

Sewage Pumps No. 2 through 5 at the East Street Pump Station were inspected. All sewage pumps have 350 hp motors, and were installed around 1984. All of the sewage pumps were found to be in overall moderate condition with the exception of Pump No. 2, which was in good condition. Only Sewage Pump No. 2 was in service at the time of inspection. Observations are as follows:

- Sewage Pump No. 2 had minor corrosion. The shaft and the housing were in good condition, but the volute was worn. The support and base was in moderate condition. Sewage Pump No. 2 showed no leakage from the seals or piping and the motor displayed no excessive noise or vibration.
- Sewage Pump No. 3 suffered extensive corrosion. The volute was corroded significantly. The support and base was in moderate condition.
- Sewage Pumps No. 4 and No. 5 showed moderate corrosion, specifically to the volute. The supports and bases were in poor condition.
- Sewage Pump No. 5 was out of service and the volute was open. The interior of this volute was inspected and found to be in excellent condition for the age of the pump. The motor for Sewage Pump No. 5 was missing.
- The paint coat for all sewage pumps was in moderate condition.
- The concrete supports for all pumps and base elbows appeared to be in decent condition, with damage limited to the metal support base.
- The associated instrumentation, controls, valves, and piping for all sewage pumps was in moderate condition.
- The sewage pumps are all reported to be fairly reliable and pose a low operations and maintenance burden.
- The sewage pumps all are reported to have sufficient capacity to meet process and regulatory requirements.

Because Main Sewage Pumps No. 3 through No. 5 were found to be in generally moderate condition, with moderate to significant corrosion to the base and volutes, it is anticipated that replacement would be required within 10 years. Main Sewage Pump No. 2 was in better condition, and replacement may not be required for 20 years.

Coarse Screens No. 1 and No. 2 were inspected, and found to be in very bad condition. Both coarse screens were installed in 1980. Coarse Screen No. 1 was in worse condition than Coarse Screen No. 2. Only Coarse Screen No. 2 was operating. Observations are as follows:

- Both coarse screens were significantly corroded, with extreme damage to the housing of Screen No. 1 and significant corrosive damage to the housing of Screen No. 2. The damage to the paint coat and support base structure of both screens was extreme.
- Even though Screen No. 1 was out of service, the vibration was extreme. Screen No. 2 exhibited moderate vibration.
- The motor for Screen No. 1 was in moderate condition, while the motor for Screen No. 2 was in poor condition.
- Screen No. 1 is reported to be very unreliable and pose a significant operations and maintenance burden, while Screen No. 2 was reported to be slightly less so.
- Both screens are reported have somewhat sufficient capacity for process and regulatory requirements, although both screens can get overwhelmed during large storm events.

Because Coarse Screens No. 1 and No. 2 were found to be in poor condition, with significant corrosive damage and poor reliability, it is anticipated that replacement would be required within 5 years.

Fine Screens No. 1 and No. 2 were inspected and found to also be in overall poor condition. Screen No. 1 was found to be in worse condition than Screen No. 2. Both fine screens were installed in 1980. Only Screen No. 2 was in service at the time of inspection. Observations are as follows:

- Both screens suffered from moderate to significant corrosion, with Screen No. 2 being in worse condition than Screen No. 1.
- The damage to the base support and paint coat for both screens was extensive.
- The motors appeared to be in moderate condition.
- Both screens pose a significant operations and maintenance burden on the facility and have poor reliability.
- Both screens are reported to sufficient capacity for process and regulatory requirements.

Because Fine Screens No. 1 and No. 2 were found to be in poor condition, with significant corrosive damage and poor reliability, it is anticipated that replacement would be required within 5 years.

Grit Collectors No. 1 through No. 4 were inspected and found to be in overall poor to very bad condition. Grit Collector No. 1 was installed in 1979. The remaining three grit collectors were installed in 1985. None of the grit collectors was operational at the time of inspection. Observations are as follows:

- All grit collectors were found to be severely corroded, with extensive damage to the base support and paint coat.
- All grit collector motors were found to be in poor condition, although none could be inspected for vibration or leaks as all units were out of service.
- The capacity of the grit collectors is reported to be sufficient to meet all regulatory and process demands.
- The grit collectors impose a very high operations and maintenance burden on the facility, and have very poor reliability.

Because Grit Collectors No. 1 through No. 4 were found to be in poor condition, with significant corrosive damage and poor reliability, it is anticipated that replacement would be required within 5 years.

The Turbine Generator was investigated, and found to be in overall moderate condition. The generator has a capacity of 1.3 MW and was installed around 1985. Observations are as follows:

- The generator has moderate corrosion, with some damage to the paint coat and support.
- The associated piping and valves are in moderate condition.
- The instruments and controls are in good condition.
- The generator is reported to be fairly reliable and a low operations and maintenance burden on the facility. The generator is reported to have sufficient capacity for process and regulatory requirements.

Because the generator was found to be in moderate condition, it is not anticipated that replacement would be required within 10 years. However, replacement will be necessary within the next 20 years.

The HVAC Equipment at the East Street Pump Station was investigated. Observations are as follows:

- The Exhaust Fan and Inlet Louvers are inoperable.
- The Hot Water heaters are severely corroded, and many units do not operate.
- The Boiler is operable, but is severely corroded and damaged. The boiler is a safety concern.
- The Hot Water Recirculation Pumps are severely corroded and do not work.
- The Exhaust Fans are operable but have insufficient capacity.
- The Air Handling Unit is severely corroded and does not operate.
- The Odor Control Exhaust Fan operates, but is in moderate to poor condition.
- The Heat Recovery Pumps are inoperable.
- Most of the HVAC Controls do not operate and units have to be operated by hand.

Because the HVAC Systems were found to be in extremely poor condition, with significant corrosive damage and most units inoperable, inspection and replacement of the East Street Pump Station HVAC should proceed immediately.

The Electrical Equipment in the East Street Pump Station was inspected. All equipment was installed in 1984. The following observations were made:

- MCCs 1, 1A, and 2 were inspected. The location of MCC 1 is poor, with an obstructed path of egress. There is evidence of splashing on MCC 1A. For both MCCs arc flash and maintenance labels were missing. There was no indication of recent testing.
- The Panel Boards was in good condition.
- The Switchboard was missing labels for arc flash and maintenance, but was otherwise in good condition.

The electrical equipment is functional, but considering the age of the equipment and the suboptimal location of some MCCs, testing should be conducted and replacement should be planned for within 10 years.

3.2.2. Boulevard Pump Station

Sewage Pumps No. 1 through 4 were inspected. All sewage pumps have 400 hp motors, and were installed around 1988. Sewage Pumps No. 1 and No. 2 were found to be in overall moderate condition, while Sewage Pumps No. 3 and No. 4 were found to be in poor condition. Sewage Pumps No. 2 and No. 4 were in service at the time of inspection. Observations are as follows:

- Sewage Pumps No. 3 and No. 4 exhibited more corrosion than Sewage Pumps No. 1 and No. 2, although all corrosion was mild to moderate. The volute of Sewage Pump No. 4 appeared especially corroded.
- The paint coat for all Sewage Pumps No. 1 and No. 2 was in fair condition. The paint coat for Sewage Pump No. 4 was in moderate condition, and the paint coat for Sewage Pump No. 3 was in poor condition.
- The supports and bases for all the sewage pumps ranged from moderate to good condition.
- Sewage Pump No. 2 showed significant leakage from the seal, while Sewage Pump No. 4 showed no leakage at all. Vibration from Sewage Pumps No. 2 and No. 4 was mild. The other sewage pumps which were out of service at the time of inspection could not be inspected for noise, vibration, or leaks.
- The motors for all the pumps were in good condition. The associated instrumentation was in good to moderate condition. The process piping and valves for all sewage pumps except Sewage Pump No. 3 were in good to moderate condition. The check valve for Sewage Pump No. 3 was badly corroded.
- The sewage pumps are all reported to be fairly reliable and pose a low operations and maintenance burden.
- The sewage pumps all are reported to have sufficient capacity to meet process and regulatory requirements.

Because Main Sewage Pumps No. 1 and No. 2 were found to be in generally moderate condition, with only some corrosion and superficial issues, it is anticipated that replacement would be required within 10 years. Main Sewage Pumps No. 3 and No. 4 were in worse condition, and it is anticipated that replacement would be required in 5 years.

Coarse Screens No. 1 and No. 2 were inspected, and found to be in poor condition. Both coarse screens were installed in 1985. Coarse Screen No. 2 was in slightly worse

condition than Coarse Screen No. 1. Only Coarse Screen No. 1 was operating at the time of inspection. Observations are as follows:

- Both coarse screens were significantly corroded. The damage to the paint coat and support base structure of both screens was extensive, with extreme damage to portions of Screen No. 2.
- The motors were in moderate condition, with the motor for Screen No. 2 suffering extensive corrosion.
- Both screens are reported to be unreliable and pose a significant operations and maintenance burden.
- The gates for Screen No. 1 were operable, but the screen suffered extensive ragging.
- Both screens are reported to not have sufficient capacity for process.

Because Coarse Screens No. 1 and No. 2 were found to be in poor condition, with significant corrosive damage and poor reliability, it is anticipated that replacement would be required within 5 years.

Fine Screens No. 1 and No. 2 were inspected and found to be in overall poor condition. Screen No. 1 was found to be in worse condition than Screen No. 2. Both fine screens were installed around 1985. Only Screen No. 1 was in service at the time of inspection. Observations are as follows:

- Both screens suffered from significant corrosion. For Screen No. 2, the housing was in fair condition, but the chains were severely corroded.
- The corrosive damage to the base support for Screen No. 1 was severe, while the damage to Screen No. 2 was moderate. The damage to the paint coat for both screens was extensive.
- The motor appeared to be in moderate to poor condition for both screens. Screen No. 1 was observed to be noisy. Screen No. 2 was out of service at the time of inspection, but is reported to be functional.
- Both screens pose a significant operations and maintenance burden on the facility and have poor reliability.
- Both screens are reported to not have sufficient capacity for process.

Because Fine Screens No. 1 and No. 2 were found to be in poor condition, with significant corrosive damage and poor reliability, it is anticipated that replacement would be required within 5 years.

Grit Collectors No. 1 through No. 4 were inspected and found to be in overall very bad condition. The grit collectors were installed around 1988. None of the grit collectors was operational at the time of inspection. Observations are as follows:

- All grit collectors were found to be severely corroded, with extensive damage to the base support and paint coat.
- All grit collector motors were found to be in moderate condition, although none could be inspected for vibration or leaks as all units were out of service.
- The capacity of the grit collectors is sufficient to meet all regulatory requirements, but insufficient for process demands.
- The grit collectors impose a very high operations and maintenance burden on the facility, and have very poor reliability.

Because Grit Collectors No. 1 through No. 4 were found to be in poor condition, with significant corrosive damage and poor reliability, it is anticipated that replacement would be required within 5 years.

The Turbine Generator was investigated, and found to be in overall moderate condition. The generator has a capacity of 1.3 MW and was installed around 1985. Observations are as follows:

- The generator has moderate corrosion, with some damage to the paint coat and support.
- The associated piping and valves are in good condition.
- The instruments and controls are in moderate to good condition.
- The generator is reported to be fairly reliable but a moderate operations and maintenance burden on the facility. The generator has sufficient capacity for process and regulatory requirements.

Because the generator was found to be in moderate condition, it is not anticipated that replacement would be required within 10 years. However, replacement will be necessary within the next 20 years.

The HVAC Equipment at the Boulevard Pump Station was investigated. Observations are as follows:

- The Air Handling unit was inoperable. No ventilation is provided within the building. The ductwork, piping, valves, and instruments are in extremely poor condition. There is significant damage to the base and supports.
- The Odor Control Fan base and ductwork is completely corroded.
- The Heat Recirculation System is inoperable. The ductwork and piping is corroded, and the pump does not operate.
- The boiler seals are damaged and Boiler No. 2 is leaking. There is minimal damage and corrosion.
- The Hot Water Circulation Pumps are in moderate condition, but suffer from corrosion and one unit is inoperable.
- The Air Handling Unit ductwork is in good condition, but the controls do not work and the unit is inoperable.
- The Supply Fan works, but the Dampers are inoperable.
- The Exhaust Fan operates, but the Fan Dampers and Entrance Louvers are inoperable.
- Most of the HVAC Controls do not operate, and equipment has to be operated manually.

Because the HVAC Systems were found to be in extremely poor condition, with significant corrosive damage and most units inoperable, inspection and replacement of the Boulevard HVAC should proceed immediately.

The Electrical Equipment in the Boulevard Pump Station was inspected. All equipment was installed in 1989. The following observations were made:

- MCCs 1 and 2 were inspected. The location of MCC 2 is poor, with a water line overhead. For both MCCs arc flash and maintenance labels were missing. There was no indication of recent testing.
- The Switchboard was missing labels for arc flash and maintenance, but was otherwise in good condition.

The electrical equipment is functional, but considering the age of the equipment and the suboptimal location of MCC 2, testing should be conducted and replacement should be planned for within 10 years.

3.2.3. State & Union Pump Station

Sewage Pumps No. 1 through 4 were inspected. Sewage Pumps No. 1 and No. 2 have 25 hp motors. Sewage Pump No. 3 has a 50 hp motor. The motor rating for Sewage Pump No. 4 could not be determined. The pumps were installed around 1980, except for Pump No. 3, which was replaced around 2001. The condition of the pumps varies. Pump No. 1 is in very bad condition, Pumps No. 2 and No. 4 are in poor condition, and Pump No. 3, which was replaced recently, is in moderate condition. Pump No. 1 is inoperable, and in fact, hasn't operated in approximately 25 years. Only Pumps No. 3 and No. 4 were in service at the time of inspection. Observations are as follows:

- All of the pumps are significantly corroded, with damage to the base support and paint coat. For Pump No. 2, it appears as if the damage is becoming structural.
- All the pump motors appeared to be in good condition, and there was no external indication for why Pump No. 1 was inoperable.
- The instruments for Pumps No. 2 and No. 3 were in good condition.. Pump No. 4 was missing gauges, and the gauges for Pump No. 1 were in poor condition.
- The pumps are all fairly reliable and pose a modest operations and maintenance burden on the facility, with Pump No. 3 reported to be more of a burden than the other remaining operating pumps.
- The pumps are reported to have sufficient capacity for regulatory and process requirements.

Pump No. 1 should be repaired or replaced. Pumps No. 2 and No. 4 are in poor condition, and it is anticipated that replacement would be required within 5 years. Pump No. 3 is in slightly better condition, and it is anticipated that replacement would be required within 10 years. It is also reported that plans are in the works to replace the entire pump station with a new facility in a location more conducive to operation and maintenance.

The HVAC Equipment at the State & Union Pump Station was investigated. Observations are as follows:

- The Exhaust Fan is inoperable.
- The Gas Fired Unit Heaters are inoperable and were abandoned in place.

All HVAC Equipment for the State & Union Pump Station will require replacement.

The Electrical Equipment at the State & Union Pump Station was investigated. Observations are as follows:

- The Switchboard is very old, having been installed in 1959. Corrosion was observed. The Switchboard was missing labels for arc flash and maintenance.

Considering the age and condition of the Switchboard, replacement should be considered for within 5 years.

3.2.4. Barnes Avenue Pump Station

The inspection of Sewage Pumps No. 1 and No. 2 was limited because these pumps are submersible. The pumps are nonetheless reported to be in good condition, and the following observations were made:

- The pumps are all reported to be fairly reliable and pose a modest operations and maintenance burden on the facility.
- The pumps are reported to have sufficient capacity for process and regulatory requirements.
- The pumps are reported to clog frequently.

Because the pumps were found to be in good condition, it is not anticipated that replacement would be required within 10 years. Thus, a 20 year timeframe is assumed for these pumps.

The Generator was investigated, and found to be in overall moderate condition. The generator has a capacity of 200 kW and was installed around 2006. Observations are as follows:

- The generator has virtually no corrosion, damage to the paint coat, or damage to the base supports.
- The associated piping and valves are in good condition.
- The instruments and controls are good condition.
- The generator is reported to not be very reliable. There have been maintenance issues since the time of installation.

Because the generator was found to be in good condition and is relatively new, it is not anticipated that replacement would be required within 10 years. Thus, a 20 year timeframe is assumed for these pumps. However, the maintenance issues need to be resolved to keep this unit in service for the next 10-20 years.

The HVAC Equipment at the Barnes Avenue Pump Station was investigated. Observations are as follows:

- The Air Handling Unit is inoperable.
- The Exhaust Fan is inoperable.
- The Steam Unit Heater is inoperable.
- The Oil Boiler is operational and in moderate condition with the exception of the piping and valves, which are in poor condition. No ventilation is provided for the boiler. The Fuel Oil Tank is in moderate condition.
- The Atmospheric Unit is in good condition, except the pipes have corroded and are in need of replacement.

All HVAC Equipment for the Barnes Avenue Pump Station will require replacement, with the exception of the Atmospheric Unit, Boiler, and Fuel Oil Storage Tank. Associated piping, valves and ductwork for these units requires replacement.

3.2.5. James Street Siphon

Bar Screens No. 1 and No. 2 were inspected, and found to be in poor condition. Both bar screens were installed in 1985. Bar Screen No. 2 was inoperable at the time of inspection, and had been for several months. The chains had bound. Bar Screen No. 1 was operating at the time of inspection. Observations are as follows:

- Both screens were significantly corroded. The damage to the paint coat and support base structure of both screens was significant, with more extreme damage to portions of Screen No. 1.
- The motors were in poor condition.
- Both screens are reported to only be moderately reliable and pose a operations and maintenance burden on the facility.
- Both screens are reported to not have sufficient capacity for process requirements.

Because Bar Screens No. 1 and No. 2 were found to be in poor condition, with significant corrosive damage and poor reliability, it is anticipated that replacement would be required within 5 years even with repairs to the chains for Screen No. 2.

The Electrical Equipment at the James Street Pump Station was investigated. Observations are as follows:

- The Main Service and Lighting Panels are old, having been installed in 1976. Extensive corrosion was observed. The panel was missing labels for arc flash and maintenance. The Main Service Panel is in an unventilated location. Both panels are functional.

Considering the age and condition of the panels and the extent of corrosion, replacement should be considered for within 5 years.

A summary of the condition of critical equipment at the East Shore WPAF and the pump stations included in this study is provided in Table 3-1.

Table 3-1.
East Shore WPAF Critical Equipment Condition

Facility and Equipment	Overall Condition	
East Shore WPAF- Primary Treatment		
Bar Screens	4	Fair to Poor
Grit Collectors	3	Fair
Grit Classifiers	3	Fair
Sewage Pumps #1, #3, #5	2	Good
Sewage Pumps #2, #4	2	Good
Primary Clarifiers	2	Good
Scrubber – Main Building	2	Good
Scrubber – RJ	3	Fair
Scrubber – X flow	3	Fair
Scrubber – Primary	2	Good
East Shore WPAF- Secondary Treatment		
Aeration Blowers	2	Good
Aeration Tanks	2	Good
Final Clarifiers	3	Fair
Hypochlorite Pumps	2	Good
Hypo Mixers	2	Good
Plant Water Pump #1	4	Fair to Poor
Plant Water Pumps #2, #3	2	Good
Plant Water Strainers	4	Fair to Poor
East Shore WPAF- Solids Handling/Disposal		
Gravity Belt Thickeners	3	Fair
TWAS Pumps	2	Good
TPS Pumps	2	Good
Gravity Thickener	3	Fair
Sludge Holding Tank	4	Fair to Poor

Facility and Equipment	Overall Condition	
East Shore WPAF- Misc. Equipment		
Portable 6"Emergency Pump	3	Fair
Plant Generator	3	Fair
LARGE PUMP STATIONS		
East Street	3	Fair
Boulevard	3	Fair
SMALL PUMP STATIONS		
State & Union	4	Fair to Poor
Barnes Avenue		
Pumps	2	Good
Generator	2	Good
James Street Siphon		
Bar Screens	3	Fair

4. Capital Improvement Program Impacts

In Section 3, Condition Assessment, the condition of each piece of equipment on the critical equipment list was discussed. Based on the estimated remaining useful life of the equipment and the condition of the equipment, each piece of equipment was given an estimated replacement timeframe. These timeframes are for replacement in either the next 5, 10 or 20 years.

In order to better inform the Authority in future capital planning, estimates have been derived of the cost to replace each piece of equipment in the timeframes assigned to that equipment. Given the limited scope of this assessment, it was not possible to develop information for each piece of equipment that could be utilized in estimating the cost for replacement of that equipment. Information that would be required to provide estimated replacement costs includes quantity take-offs, vendor quotes, potential installation methods/constraints and staging/Maintenance of Plant Operations (MOPO) constraints. Each of these factors is critical in determining replacement costs for existing equipment.

In place of developing such information, estimated replacement costs in the 2003 asset database were used as discussed in previous sections of the Report. The costs in this database include only costs for replacement of individual equipment as estimated by American Appraisals at the time they conducted their study. However, the equipment itself is only part of an overall system that is required to make that equipment function as intended. In addition to the equipment, such ancillary items as electrical conduit/wiring, piping/ductwork, valving, controls, etc. are required to form a complete system. In order to provide the Authority with the most comprehensive replacement costs possible for a given piece of equipment given the limited scope of this study, "rule-of-thumb" escalation factors have been added to the asset database costs for individual pieces of equipment in an attempt to account for ancillary items that would generally need to be replaced in addition to the equipment itself to make for a fully upgraded system in the replacement timeframes noted for each piece of equipment.

In addition to ancillary systems, there are a number of other factors that will add to the cost to replace critical equipment. Such factors include the following:

- Staging, including temporary items required to keep critical systems in service
- Contractors' overhead and profit
- General conditions (Division 1 items, including project administration)
- Escalation from the year 2003 dollars in the 2003 asset database to present day dollars, and then from present day dollars to the estimated midpoint of construction.

- Contingency to account for the many unknowns that can be expected when detailed take-offs and vendor quotes have not been obtained, and effort has not yet been expended to detail construction methods and other factors that are critical to replacement costs.

In addition, because these costs were not developed with detailed information, they can be considered planning-level. The Association for the Advancement of Cost Engineering, International (AACE), publishes a Cost Estimate Classification System which describes and categorizes the various cost estimates that are generally developed throughout a project, from project conceptualization through completion of detailed design. AACE assigns each type of estimate a category, or class, and provides guidance on the typical range of accuracy for each cost estimate class. The more advanced the project is, the more information is available with which to develop cost estimates, and thus, the more accurate these cost estimates should be. At the very early stages of project conceptualization, it is recognized that very little is known about the project and hence, the cost estimates are expected to not be very accurate.

Given the lack of detailed information that has gone in to the equipment replacement cost estimates as described herein, these cost estimates can be considered to be at the screening/conceptualization phase, and thus can be considered to be Class 5 estimates. The AACE states that Class 5 cost estimates generally have a range of accuracy of -50% to +100%. Thus, for each piece of equipment, the factors described above were added to the 2003 asset database replacement cost for that piece of equipment and a Class 5 estimate was obtained. From this Class 5 estimate, the accuracy range of -50% to +100% was applied to determine the probable range within which the total cost of equipment/ancillary system replacement would be expected to fall. After all of the factors described above are considered, a range of total costs to replace a piece of equipment is estimated. Included in Appendix C is an example calculation of the cost estimating factors that have been applied to each piece of equipment.

It should be noted that the escalation from present day dollars to the estimated midpoint of construction is based on the equipment replacement timeframe described in Section 3 for each piece of equipment. For equipment to be replaced within the next 5 years, the cost is escalated 5 years at 3% per year (compounded). For equipment to be replaced within the next 10 years, the cost is escalated 10 years at 3% per year, and for equipment to be replaced within the next 20 years, the cost is escalated 20 years at 3% per year. Based on these cost escalations, replacement costs referenced in this report are in future years' dollars, not in present day dollars.

Notable exceptions to this process are for the main sewage pumps, hypochlorite mixing pumps and portable emergency pump at the East Shore WPAF, and the standby generator and pumps at the Barnes Ave Pump Station. Replacement costs for these items were not

included in the 2003 asset database. Thus, costs for replacement of this equipment was developed based on consultation with equipment vendors and based on Pirnie's experience. The same factors, as described above, were then applied to "base" costs for replacement of the equipment.

Another exception to this approach is for large tankage, which includes the primary clarifiers, aeration tanks and final clarifiers. Given the fact that replacement of these tanks would not involve a large number of ancillary systems, the cost adder for ancillary systems has been eliminated from the escalation factors described above. Essentially, the cost for the tanks is assumed to include all necessary components of the tanks, including chain and flight collectors for the clarifiers and aeration piping and diffusers for the aeration tanks.

In addition, this approach was not followed for the Boulevard, East Street and State & Union Pump Stations. These three stations are essentially obsolete, and complete equipment replacement, along with major structural rehabilitation, is required. These three pump stations are also part of the Authority's Wet Weather Capacity Improvements and Nitrogen Reduction Facility Plan, dated November, 2009 and amended in February, 2011. Rather than utilize the above-described approach of developing Class 5 cost estimates, we believe that the Authority is in a better position to estimate costs for rehabilitation of these three Pump Stations, given that Facility Plan-level cost estimates were completed as part of the Wet Weather Capacity Improvements and Nitrogen Reduction Facility Plan. Because these estimates would be expected to have considerably more detail than the estimates based on the 2003 asset database, costs from this Facility Plan were utilized as the basis for these three pump stations and are presented in the 5-10 year planning timeframe in Table 4-3 of this report, consistent with the Authority's capital improvement plan. Escalation was added to bring Facility Plan costs to the estimated 5-10 year construction timeframe. It should be noted that the State & Union Pump Station is scheduled for complete replacement in a new location, which appears to be reflected in the cost estimates. Costs provided in the Facility Plan are considered to be AACE Level 4 estimate, with an expected range of accuracy of -30% to +50%. Because full rehabilitation/replacement of these pump stations is not scheduled to occur within the next five-years as would be suggested based on the condition assessment, it is recommended that the Authority implement interim improvements to reduce the risk of failure of key components. These include interim improvements to the bar screens, grit collectors and HVAC-odor control systems until such time full rehabilitation/replacement of the pump station can be completed. The estimated cost of the interim improvement requirements is included in the 1-5 year planning timeframe in Table 4-2 of this report.
A summary of estimated replacement costs for equipment on the critical equipment list is provided in Table 4-1, below. A more detailed breakdown of these costs is included in Appendix D. These estimated costs have been further broken-down by replacement

timeframe. Tables 4-2 through 4-4 show summary of replacement costs over the 5, 10 and 20 year planning timeframe, respectively.

Table 4-1.
Summary of Estimated Replacement Costs Organized by Process Area

	Replacement Timeframe (Years)	Estimated Cost at Replacement	Estimated Range of Costs at Replacement Date	
			Low End	High End
East Shore WPAF- Primary Treatment				
Bar Screens	5	$796,000	$398,000	$1,592,000
Grit Collectors	10	$2,052,000	$1,028,000	$4,104,000
Grit Classifiers	10	$152,000	$76,000	$304,000
Main Sewage Pumps #1, #3, #5	20	$1,437,000	$720,000	$2,874,000
Main Sewage Pumps #2, #4	20	$1,596,000	$798,000	$3,192,000
Primary Clarifiers	20	$39,343,000	$19,673,000	$78,686,000
Scrubber – Main Building	10	$824,000	$412,000	$1,648,000
Scrubber – RJ	10	$1,988,000	$994,000	$3,976,000
Scrubber – X flow	10	$196,000	$98,000	$392,000
Scrubber – Primary	10	$8,971,000	$4,486,000	$17,942,000
East Shore WPAF- Secondary Treatment				
Aeration Blowers	20	$14,720,000	$7,360,000	$29,440,000
Aeration Tanks	20	$53,585,000	$26,793,000	$107,170,000
Final Clarifiers	10	$17,014,000	$8,507,000	$34,028,000
Hypochlorite Pumps	20	$125,000	$63,000	$250,000
Hypo Mixers	20	$256,000	$128,000	$512,000
Plant Water Pump #1	5	$221,000	$111,000	$442,000
Plant Water Pumps #2, #3	20	$688,000	$344,000	$1,376,000
Plant Water Strainers	20	$1,068,000	$534,000	$2,136,000
East Shore WPAF- Solids Handling/Disposal				
Gravity Belt Thickeners	10	$5,436,000	$2,718,000	$10,872,000
TWAS Pumps	20	$196,000	$98,000	$392,000
TPS Pumps	20	$232,000	$116,000	$464,000
Gravity Thickener	10	$2,065,000	$1,033,000	$4,130,000
Sludge Holding Tank	5	$1,639,000	$820,000	$3,278,000
East Shore WPAF- Misc. Equipment				
Portable 6"Emergency Pump	10	$68,000	$34,000	$136,000
Plant Generator	5	$510,000	$255,000	$1,020,000
PUMP STATIONS				
Interim Improvements [1]	5	$3,500,000	$1,750,000	$7,000,000
East Street	10	$24,419,000	$17,093,000	$36,629,000
Boulevard	10	$24,264,000	$16,985,000	$36,396,000
State & Union	10	$67,075,000	$46,953,000	$100,613,000
Barnes Avenue				
Pumps	20	$444,000	$222,000	$888,000
Generator	20	$639,000	$320,000	$1,278,000
James Street Siphon				
Bar Screens	5	$1,580,000	$790,000	$3,160,000
TOTAL		**$277,099,000**	**$161,710,000**	**$496,320,000**

[1] Interim improvement to East Street, Boulevard and State and Union Pump Stations to be completed within next five-years, with full rehabilitation/replacement scheduled within the next 10 years.

Table 4-2.
Summary of Replacement Costs for 1-5 Year Planning Timeframe

	Replacement Timeframe (Years)	Estimated Cost at Replacement	Estimated Range of Costs at Replacement Date	
			Low End	High End
East Shore WPAF- Primary Treatment				
Bar Screens	5	$796,000	$398,000	$1,592,000
East Shore WPAF- Secondary Treatment				
Plant Water Pump #1	5	$221,000	$111,000	$442,000
East Shore WPAF- Solids Handling/Disposal				
Sludge Holding Tank	5	$1,639,000	$820,000	$3,278,000
East Shore WPAF- Misc. Equipment				
Plant Generator	5	$510,000	$255,000	$1,020,000
PUMP STATIONS				
Interim Improvements [1]	5	$3,500,000	$1,750,000	$7,000,000
James Street Siphon				
Bar Screens	5	$1,580,000	$790,000	$3,160,000
TOTAL		**$8,246,000**	**$4,124,000**	**$16,492,000**

[1] Interim improvement to East Street, Boulevard and State and Union Pump Stations to be completed within next five-years, with full rehabilitation/replacement scheduled within the next 10 years.

Table 4-3.
Summary of Replacement Costs for 5-10 Year Planning Timeframe

	Replacement Timeframe (Years)	Estimated Cost at Replacement	Estimated Range of Costs at Replacement Date	
			Low End	High End
East Shore WPAF- Primary Treatment				
Grit Collectors	10	$2,052,000	$1,028,000	$4,104,000
Grit Classifiers	10	$152,000	$76,000	$304,000
Scrubber – Main Building	10	$824,000	$412,000	$1,648,000
Scrubber – RJ	10	$1,988,000	$994,000	$3,976,000
Scrubber – X flow	10	$196,000	$98,000	$392,000
Scrubber – Primary	10	$8,971,000	$4,486,000	$17,942,000
East Shore WPAF- Secondary Treatment				
Final Clarifiers	10	$17,014,000	$8,507,000	$34,028,000
East Shore WPAF- Solids Handling/Disposal				
Gravity Belt Thickeners	10	$5,436,000	$2,718,000	$10,872,000
Gravity Thickener	10	$2,065,000	$1,033,000	$4,130,000
East Shore WPAF- Misc. Equipment				
Portable 6"Emergency Pump	10	$68,000	$34,000	$136,000
Pump Stations				
East Street	10	$24,419,000	$17,093,000	$36,629,000
Boulevard	10	$24,264,000	$16,985,000	$36,396,000
State & Union	10	$24,419,000	$17,093,000	$36,629,000
TOTAL		**$154,524,000**	**$100,417,000**	**$251,170,000**

Table 4-4.
Summary of Replacement Costs for 10-20 Year Planning Timeframe

	Replacement Timeframe (Years)	Estimated Cost at Replacement	Estimated Range of Costs at Replacement Date	
			Low End	High End
East Shore WPAF- Primary Treatment				
Sewage Pumps #1, #3, #5	20	$1,437,000	$720,000	$2,874,000
Sewage Pumps #2, #4	20	$1,596,000	$798,000	$3,192,000
Primary Clarifiers	20	$39,343,000	$19,673,000	$78,686,000
East Shore WPAF- Secondary Treatment				
Aeration Blowers	20	$14,720,000	$7,360,000	$29,440,000
Aeration Tanks	20	$53,585,000	$26,793,000	$107,170,000
Hypochlorite Pumps	20	$125,000	$63,000	$250,000
Hypo Mixers	20	$256,000	$128,000	$512,000
Plant Water Pumps #2, #3	20	$688,000	$344,000	$1,376,000
Plant Water Strainers	20	$1,068,000	$534,000	$2,136,000
East Shore WPAF- Solids Handling/Disposal				
TWAS Pumps	20	$196,000	$98,000	$392,000
TPS Pumps	20	$232,000	$116,000	$464,000
PUMP STATIONS				
Barnes Avenue				
Pumps	20	$444,000	$222,000	$888,000
Generator	20	$639,000	$320,000	$1,278,000
TOTAL		**$114,329,000**	**$57,169,000**	**$228,658,000**

5. Conclusions and Recommendations

5.1. Factors Affecting Condition

There are several factors that affect the condition of the Authority's Critical Equipment Assets. Some of these factors are controllable, such as maintenance, and some are not, such as weather and natural disasters. Several of these factors are described below.

i) Use – All equipment has a useful or expected life. As the run-time hours increase the condition of the equipment naturally degrades due to normal wear and tear. Further, excessive starts and stops may cause pre-mature failure of equipment, especially electric motors.

ii) Maintenance – Predictive and preventative maintenance activities are necessary for any equipment to achieve its useful life and to prolong and even extend the useful life of equipment.

iii) Power Quality – The quality of electrical power supplied affects the life of electrical motors.

iv) Corrosive Environment – The equipment and facilities can be subject to corrosion from marine air because of their proximity to the Long-Island Sound, from warm wastewater contributing to production of hydrogen sulfide which is oxidized by bacteria to form corrosive sulfuric acid, and by chemicals used for treatment that are present in certain areas of the facilities.

v) Weather and Natural Disaster – Hurricanes, earthquakes, floods and tornadoes, while rare in the area, do occur and can impact the condition of equipment and facilities.

The condition assessment conducted by Pirnie serves to provide our observations and condition assessment findings at the time the inspections were conducted. The evaluation did not include identification of the root cause or combination of factors that may have resulted in the condition assessment deficiencies that were observed.

5.2. Condition Assessment Conclusions

The following conclusions can be drawn from the condition assessment:

5.2.1. East Shore WPAF

In general, large critical mechanical equipment at the WPAF, such as main sewage pumps and aeration blowers is in relatively good condition. That equipment has been recently replaced or overhauled, and can be expected to provide many more years of useful service.

However, certain areas of the plant have been allowed to deteriorate at or past their useful lives, and therefore require significant corrective maintenance. This is most notably the case in the headworks area, where many of the bar screens, grit collection equipment and associated items (such as gates) are in poor condition and have recently been out of service for extended periods of time, requiring major overhauls to bring them back into service. It is our assumption that major capital investments in these areas have not been made in such facilities because complete upgrade is planned as part of the Wet Weather Capacity Improvements and Nitrogen Reduction Project. However, as this project has been delayed, equipment that is planned to be upgraded has continued to deteriorate. If further delays in these upgrade projects are envisioned, a decision must be made to replace some of this equipment in a piece-meal fashion.

General facility upkeep is inconsistent amongst various areas of the facility. Administrative areas and the process control laboratory are generally kept in a clean, well-maintained state, as are the grassy areas of the facility and certain process areas, such as the chemical storage areas. However, most of the process areas of the plant are in need of cleaning, painting, and other general housekeeping. In addition, many of the roadways are poorly maintained, with inadequate drainage and the storage of unused or discarded materials along and adjacent to roadways.

With the exception of some recently replaced systems in the administrative areas, heating, ventilating and air conditioning throughout the plant is generally in poor condition. Many process mechanical systems throughout the plant have been negatively impacted as a result of exposure to harsh environments of moisture laden air and hydrogen sulfide gas. Inadequate ventilation and heating have reduced the operating life of equipment located within these facilities and make areas less likely to be properly maintained. Much of the equipment within process areas and on the roof show aggressive corrosion and do not function or function to a lesser degree than originally designed. Many areas are unable to provide heat, supply air, and exhaust air as a result of non-functional equipment.

Most of the structures throughout the plant are in good condition. Infrequent, minor cracking is common in concrete foundations, slabs and tank walls. Most of the joints in

the tank walls and some walkways are missing joint sealant, however repairs have been made to the waterstops in the walls and the joints do not leak. The missing joint sealant in the walkways is only an aesthetic issue; however water can get into the wall joints and freeze, which could result in spalling. The exterior face brick on many of the buildings displays some mortar loss and may require re-pointing. In general, roofs throughout the plant are past the end of their useful lives and should be replaced.

One major structural issue is the Sludge Holding Tank, which was fenced off during our site visit, reportedly because the underside of the slab is deteriorated. The tank could not be entered and the extent of deficiencies could not be observed. However, significant upgrades to this tank are necessary.

Most of the main electrical distribution equipment is original to the plant and past its useful live. Common problems are breakers not tripping when they should, or trouble re-setting breakers when they do trip. Other concerns include ground faults, lack of arc flash labeling, lack of recent testing labels on most gear and MCCs and panelboards which have code violations, including foreign piping above them and violations of required working clearance.

5.2.2. Pump Stations

The large pump stations, Boulevard and East Street and the James Street Siphon are generally in poor condition. The pumps at both facilities are in fair condition, however, the bar screens, grit removal, and gates at these facilities are well past their useful lives and in very poor condition. Complete upgrades of these two facilities are necessary, and are also included in the Authority's CIP. The State & Union Pump Station is well past it's useful live, and plans are in the works to completely replace the station in a new location. The Barnes Avenue Pump Station was also visited. This station is relatively modern compared to the other stations, and is in good condition.

5.2.1. Capital Improvement Program Needs

As discussed above, many of the major capital improvement needs are already included in the Authority's long-term CIP. In addition, the Authority is in the process of securing approval and funding from the State of Connecticut Clean Water Fund for Wet Weather Capacity Improvements and a Nitrogen Reduction Project which will encompass several of the short-term improvements required to the headworks and pump stations. Unfortunately, the implementation of the improvements is being delayed as the Authority has not yet secured approval for these projects. Should such delays continue, the Authority will need to evaluate completion of required improvements in a piece-meal fashion to minimize risks of failure.

The following provides a summary of the potential magnitude of costs that may be required over the next 5, 10 and 20 years. These costs are presented in future dollars. An analysis of those costs that are already included in the Authority's proposed Facilities Plan, prepared by CH2MHill on behalf of the Authority, and those that extend beyond the Facilities Plan has not been conducted. Based on our understanding of the Facilities Plan requirements, it would appear that there is significant overlap, however, a more detailed review would be required to assess those components that have been included or excluded.

Table 5-1.
Summary of Replacement Costs for 20 Year Planning Timeframe (Future Dollars)

	Estimated Range of Costs at Replacement Date ($ millions)			
	1-5 Years	5-10 Years	10-20 Years	Total
EAST SHORE WPAF	$2 - 6 M	$19 - 78 M	$57 - 226 M	$78 - 310 M
PUMP STATIONS	$2-10 M	$81 – 174 M	$1 - 2 M	$83 - 186 M
TOTAL	$4 - 16 M	$100- 242 M	$57 - 229 M	$161 - 496 M

5.3. Recommendations

Based on our condition assessment and review of the Authority's current Capital Improvement Plan, the following recommendations are made:

- A number of areas that were inspected are functionally past their useful lives and can no longer be effectively and efficiently maintained to meet their intended service. These facilities include:
  - East Shore WPAF headworks, including screening and grit collection systems.
  - East Street Pump Station.
  - Boulevard Pump Station.
  - State and Union Pump Station.

  The GNHWPCA has already developed a capital improvement program to address the above issues. The GNHWPCA, however, should consider accelerating plans for these facilities and implementing interim measures as needed to ensure sustained operations.

- Continue to invest in on-going maintenance and replacement of major equipment components for which a number of years of useful life are remaining, or for which the useful life can be extended by major overhauls/rebuilds of equipment.

- Maintain an ongoing inspection program to track the maintenance status of critical equipment.

- Thoroughly review and update the Computerized Maintenance Management System (CMMS) to ensure that the system is up-to-date and that maintenance items are being accomplished on the intended schedule.

- Utilize information from assessment to make informed facilities management decisions. This includes a review of the estimated capital costs for the 5, 10, and 20 year replacement periods. Ensure that adequate capital funding is in place in these time horizons to complete required replacements/upgrades.

- Especially for those upgrades in the 5 year replacement period, complete more detailed studies/conceptual designs for replacement of these items, where these studies/designs have not already been completed. Developing more informed and detailed cost estimates will allow the Authority to more accurately budget for these projects in their CIP.

- Immediately correct health and safety hazards. While not many such hazards were encountered during our inspections, there were some electrical and HVAC items which were noted as being health and safety issues.

Appendix A

List of Critical Assets Inspected

Date:	Photo:	Subject:	Location:	Discipline:
9/14/2011	1	Hypochlorite Pump No. 1	East Shore WPAF	Mechanical
9/14/2011	2	Hypochlorite Pump No. 1	East Shore WPAF	Mechanical
9/14/2011	3	Hypochlorite Pump No. 1	East Shore WPAF	Mechanical
9/14/2011	4	Hypochlorite Pump No. 2	East Shore WPAF	Mechanical
9/14/2011	5	Hypochlorite Pump No. 3	East Shore WPAF	Mechanical
9/14/2011	6	Hypochlorite Pump No. 4	East Shore WPAF	Mechanical
9/14/2011	8	Hypochlorite Pump No. 1	East Shore WPAF	Mechanical
9/14/2011	9	Hypochlorite Pump No. 1	East Shore WPAF	Mechanical
9/14/2011	10	Plant Water Pump No. 1	East Shore WPAF	Mechanical
9/14/2011	11	Plant Water Pump No. 2	East Shore WPAF	Mechanical
9/14/2011	12	Plant Water Pump No. 3	East Shore WPAF	Mechanical
9/14/2011	13	Plant Water Pump No. 1	East Shore WPAF	Mechanical
9/14/2011	14	Plant Water Pump No. 2	East Shore WPAF	Mechanical
9/14/2011	15	Plant Water Pump No. 3	East Shore WPAF	Mechanical
9/14/2011	16	Plant Water Pump No. 3	East Shore WPAF	Mechanical
9/14/2011	17	Plant Water Strainer No. 1	East Shore WPAF	Mechanical
9/14/2011	18	Plant Water Strainer No. 2	East Shore WPAF	Mechanical
9/14/2011	19	Plant Water Strainer No. 1	East Shore WPAF	Mechanical
9/14/2011	20	Plant Water Strainer No. 1	East Shore WPAF	Mechanical
9/14/2011	21	Plant Water Strainer No. 3	East Shore WPAF	Mechanical
9/14/2011	22	Final Clarifier No. 1	East Shore WPAF	Mechanical
9/14/2011	23	Final Clarifier No. 2	East Shore WPAF	Mechanical
9/14/2011	24	Final Clarifier No. 2	East Shore WPAF	Mechanical
9/14/2011	25	Final Clarifier No. 5	East Shore WPAF	Mechanical
9/14/2011	26	Final Clarifier No. 6	East Shore WPAF	Mechanical
9/14/2011	27	Final Clarifier No. 7	East Shore WPAF	Mechanical
9/14/2011	28	Final Clarifier No. 7	East Shore WPAF	Mechanical
9/14/2011	29	Final Clarifier No. 7	East Shore WPAF	Mechanical
9/14/2011	30	Final Clarifier No. 7	East Shore WPAF	Mechanical
9/14/2011	31	Final Clarifier No. 7	East Shore WPAF	Mechanical
9/14/2011	32	Final Clarifier No. 7	East Shore WPAF	Mechanical
9/14/2011	33	Final Clarifier No. 8	East Shore WPAF	Mechanical
9/14/2011	34	Final Clarifier No. 4	East Shore WPAF	Mechanical
9/14/2011	36	Final Clarifier No. 3	East Shore WPAF	Mechanical
9/14/2011	37	Aeration Blower No. 1	East Shore WPAF	Mechanical
9/14/2011	38	Aeration Blower No. 1	East Shore WPAF	Mechanical
9/14/2011	39	Aeration Blower No. 2	East Shore WPAF	Mechanical
9/14/2011	40	Aeration Blower No. 3	East Shore WPAF	Mechanical
9/14/2011	41	Aeration Blower No. 4	East Shore WPAF	Mechanical
9/14/2011	42	Aeration Blower No. 5	East Shore WPAF	Mechanical
9/14/2011	43	Aeration Tank No. 1	East Shore WPAF	Mechanical
9/14/2011	44	Aeration Tank No. 2	East Shore WPAF	Mechanical
9/14/2011	45	Aeration Tank No. 3	East Shore WPAF	Mechanical
9/14/2011	46	Aeration Tank No. 4	East Shore WPAF	Mechanical
9/14/2011	46	Hypochlorite Mixing Pump	East Shore WPAF	Mechanical
9/14/2011	48	Bar Screen No. 1	East Shore WPAF	Mechanical
9/14/2011	49	Bar Screen No. 2	East Shore WPAF	Mechanical
9/14/2011	50	Bar Screen No. 2	East Shore WPAF	Mechanical
9/14/2011	51	Bar Screen No. 2	East Shore WPAF	Mechanical
9/14/2011	52	Grit Collector No. 1	East Shore WPAF	Mechanical
9/14/2011	53	Grit Collector No. 2	East Shore WPAF	Mechanical

Date:	Photo:	Subject:	Location:	Discipline:
9/14/2011	54	Grit Collector No. 2	East Shore WPAF	Mechanical
9/14/2011	55	Grit Collector No. 3	East Shore WPAF	Mechanical
9/14/2011	56	Grit Collector No. 4	East Shore WPAF	Mechanical
9/14/2011	57	Grit Classifier No. 1	East Shore WPAF	Mechanical
9/14/2011	58	Grit Classifier No. 2	East Shore WPAF	Mechanical
9/14/2011	59	Primary Clarifier No. 2	East Shore WPAF	Mechanical
9/14/2011	60	Primary Clarifier No. 3	East Shore WPAF	Mechanical
9/14/2011	61	Primary Clarifier No. 3	East Shore WPAF	Mechanical
9/14/2011	62	Primary Clarifier No. 1	East Shore WPAF	Mechanical
9/14/2011	63	Primary Clarifier No. 1	East Shore WPAF	Mechanical
9/14/2011	64	Primary Scrubber	East Shore WPAF	Mechanical
9/14/2011	65	Primary Scrubber	East Shore WPAF	Mechanical
9/15/2011	1	RJ Scrubber	East Shore WPAF	Mechanical
9/15/2011	2	RJ Scrubber	East Shore WPAF	Mechanical
9/15/2011	3	RJ Scrubber	East Shore WPAF	Mechanical
9/15/2011	4	Chemical Feed System	East Shore WPAF	Mechanical
9/15/2011	5	Chemical Feed System	East Shore WPAF	Mechanical
9/15/2011	6	Chemical Feed System	East Shore WPAF	Mechanical
9/15/2011	7	Chemical Feed System	East Shore WPAF	Mechanical
9/15/2011	8	Chemical Feed System	East Shore WPAF	Mechanical
9/15/2011	9	Chemical Feed System	East Shore WPAF	Mechanical
9/15/2011	10	Chemical Feed System	East Shore WPAF	Mechanical
9/15/2011	11	Chemical Feed System	East Shore WPAF	Mechanical
9/15/2011	12	Chemical Feed System	East Shore WPAF	Mechanical
9/15/2011	13	Chemical Feed System	East Shore WPAF	Mechanical
9/15/2011	14	Chemical Feed System	East Shore WPAF	Mechanical
9/15/2011	15	Chemical Feed System	East Shore WPAF	Mechanical
9/15/2011	16	Chemical Feed System	East Shore WPAF	Mechanical
9/15/2011	17	Chemical Feed System	East Shore WPAF	Mechanical
9/15/2011	18	Chemical Feed System	East Shore WPAF	Mechanical
9/15/2011	18	X-Flow Scrubber	East Shore WPAF	Mechanical
9/15/2011	19	Main Building Scrubber	East Shore WPAF	Mechanical
9/15/2011	20	Main Building Scrubber	East Shore WPAF	Mechanical
9/15/2011	21	6in Portable Pump	East Shore WPAF	Mechanical
9/15/2011	22	Main Sewage Pump No. 5	East Shore WPAF	Mechanical
9/15/2011	23	Main Sewage Pump No. 4	East Shore WPAF	Mechanical
9/15/2011	24	Main Sewage Pump No. 3	East Shore WPAF	Mechanical
9/15/2011	25	Main Sewage Pump No. 2	East Shore WPAF	Mechanical
9/15/2011	26	Main sewage Pump No. 1	East Shore WPAF	Mechanical
9/15/2011	27	Thickened Waste Sludge Pump No. 1	East Shore WPAF	Mechanical
9/15/2011	28	Thickened Waste Sludge Pump No. 2	East Shore WPAF	Mechanical
9/15/2011	29	Main Sewage Pump No. 5	East Shore WPAF	Mechanical
9/15/2011	30	Main Sewage Pump No. 4	East Shore WPAF	Mechanical
9/15/2011	31	Main Sewage Pump No. 3	East Shore WPAF	Mechanical
9/15/2011	32	Main sewage Pump No. 2	East Shore WPAF	Mechanical
9/15/2011	33	Main Sewage Pump No. 1	East Shore WPAF	Mechanical
9/15/2011	34	Main Sewage Pump No. 3	East Shore WPAF	Mechanical
9/15/2011	35	Thickened Primary Sludge Pump No. 1	East Shore WPAF	Mechanical
9/15/2011	36	Thickened Primary Sludge Pump No. 1	East Shore WPAF	Mechanical
9/15/2011	37	Gravity Thickener	East Shore WPAF	Mechanical
9/15/2011	38	Gravity Thickener	East Shore WPAF	Mechanical

Date:	Photo:	Subject:	Location:	Discipline:
9/15/2011	39	Sludge Holding Tank	East Shore WPAF	Mechanical
9/15/2011	40	Gravity Thickener	East Shore WPAF	Mechanical
9/15/2011	41	Sludge Holding Tank	East Shore WPAF	Mechanical
9/15/2011	42	Plant Generator	East Shore WPAF	Mechanical
9/15/2011	43	Plant Generator	East Shore WPAF	Mechanical
9/15/2011	44	Gravity Belt Thickener No. 2	East Shore WPAF	Mechanical
9/15/2011	45	Gravity Belt Thickener No. 1	East Shore WPAF	Mechanical
9/15/2011	47	Main Sewage No. 1	State & Union Pump Station	Mechanical
9/15/2011	48	Main Sewage No. 4	State & Union Pump Station	Mechanical
9/15/2011	49	Main Sewage No. 3	State & Union Pump Station	Mechanical
9/15/2011	52	Main Sewage No. 4	State & Union Pump Station	Mechanical
9/15/2011	53	Main Sewage No. 3	State & Union Pump Station	Mechanical
9/15/2011	54	Main Sewage No. 2	State & Union Pump Station	Mechanical
9/15/2011	56	Main Sewage No. 2	State & Union Pump Station	Mechanical
9/15/2011	56	Bar Screen No. 2	James Street Pump station	Mechanical
9/15/2011	57	Bar Screen No. 1	James Street Pump station	Mechanical
9/15/2011	58	Generator	Barnes Avenue Pump Station	Mechanical
9/15/2011	59	Main Sewage No. 1	Barnes Avenue Pump Station	Mechanical
9/15/2011	60	Main Sewage No. 1	Barnes Avenue Pump Station	Mechanical
9/16/2011	61	Grit Collector No. 1	East Street Pump Station.	Mechanical
9/16/2011	62	Grit Collector No. 2	East Street Pump Station.	Mechanical
9/16/2011	63	Grit Collector No. 3	East Street Pump Station.	Mechanical
9/16/2011	64	Grit Collector No. 4	East Street Pump Station.	Mechanical
9/16/2011	65	Coarse Screen No. 1	East Street Pump Station.	Mechanical
9/16/2011	66	Coarse Screen No. 2	East Street Pump Station.	Mechanical
9/16/2011	67	Coarse Screen No. 1	East Street Pump Station.	Mechanical
9/16/2011	68	Coarse Screen No. 1	East Street Pump Station.	Mechanical
9/16/2011	69	Fine Screen No. 1	East Street Pump Station.	Mechanical
9/16/2011	70	Fine Screen No. 2	East Street Pump Station.	Mechanical
9/16/2011	71	Generator	East Street Pump Station.	Mechanical
9/16/2011	72	Main Sewage Pump No. 2	East Street Pump Station.	Mechanical
9/16/2011	73	Main Sewage Pump No. 2	East Street Pump Station.	Mechanical
9/16/2011	74	Main Sewage Pump No. 3	East Street Pump Station.	Mechanical
9/16/2011	75	Main Sewage Pump No. 4	East Street Pump Station.	Mechanical
9/16/2011	76	Main Sewage Pump No. 5	East Street Pump Station.	Mechanical
9/16/2011	77	Main Sewage Pump No. 4	East Street Pump Station.	Mechanical
9/16/2011	78	Main Sewage Pump No. 3	East Street Pump Station.	Mechanical
9/16/2011	79	Main Sewage Pump No. 2	East Street Pump Station.	Mechanical
9/16/2011	80	Grit Collector No. 1	Boulevard Pump Station	Mechanical
9/16/2011	81	Grit Collector No. 2	Boulevard Pump Station	Mechanical
9/16/2011	82	Grit Collector No. 3	Boulevard Pump Station	Mechanical
9/16/2011	83	Grit Collector No. 4	Boulevard Pump Station	Mechanical
9/16/2011	84	Coarse Screen No. 1	Boulevard Pump Station	Mechanical
9/16/2011	85	Coarse Screen No. 1	Boulevard Pump Station	Mechanical
9/16/2011	86	Coarse Screen No. 2	Boulevard Pump Station	Mechanical
9/16/2011	87	Fine Screen No. 1	Boulevard Pump Station	Mechanical
9/16/2011	88	Fine Screen No. 2	Boulevard Pump Station	Mechanical
9/16/2011	89	Main Sewage Pump No. 1	Boulevard Pump Station	Mechanical
9/16/2011	90	Main Sewage Pump No. 2	Boulevard Pump Station	Mechanical
9/16/2011	91	Main Sewage Pump No. 3	Boulevard Pump Station	Mechanical
9/16/2011	92	Main Sewage Pump No. 4	Boulevard Pump Station	Mechanical

Date:	Photo:	Subject:	Location:	Discipline:
9/16/2011	93	Generator	Boulevard Pump Station	Mechanical
9/16/2011	95	Main Sewage Pump No. 4	Boulevard Pump Station	Mechanical
9/16/2011	96	Main Sewage Pump No. 3	Boulevard Pump Station	Mechanical
9/16/2011	97	Main Sewage Pump No. 3	Boulevard Pump Station	Mechanical
9/16/2011	98	Main Sewage Pump No. 2	Boulevard Pump Station	Mechanical
9/16/2011	99	Main Sewage Pump No. 1	Boulevard Pump Station	Mechanical
9/16/2011	100	Headworks Inlet/Outlet Gates	East Shore WPAF	Mechanical
9/16/2011	101	Headworks Inlet/Outlet Gates	East Shore WPAF	Mechanical
9/16/2011	102	Headworks Inlet/Outlet Gates	East Shore WPAF	Mechanical
9/16/2011	103	Headworks Inlet/Outlet Gates	East Shore WPAF	Mechanical
9/16/2011	104	Headworks Inlet/Outlet Gates	East Shore WPAF	Mechanical
9/16/2011	106	Grit Blowers	East Shore WPAF	Mechanical
9/19/2011	2089	Air Handling Unit	James Street Pump station	HVAC
9/19/2011	2090	Exhaust Fan	James Street Pump station	HVAC
9/19/2011	2091	Unit Heater	James Street Pump station	HVAC
9/19/2011	2092	Boiler	James Street Pump station	HVAC
9/19/2011	2093	Condensate Pump	James Street Pump station	HVAC
9/19/2011	2094	Fuel Oil Tank	James Street Pump station	HVAC
9/19/2011	2095	Air Handling Unit	Boulevard Pump Station	HVAC
9/19/2011	2097	Odor Control Exhaust Fan	Boulevard Pump Station	HVAC
9/19/2011	2098	Heat Recirculating Coil	Boulevard Pump Station	HVAC
9/19/2011	2099	Heat Recirculating Loop Pump	Boulevard Pump Station	HVAC
9/19/2011	2100	Boilers	Boulevard Pump Station	HVAC
9/19/2011	2101	Hot Water Circulation Pumps	Boulevard Pump Station	HVAC
9/19/2011	2102	Air Handling Unit - Main Pump Room	Boulevard Pump Station	HVAC
9/19/2011	2103	Return	Boulevard Pump Station	HVAC
9/19/2011	2104	Supply Fan	Boulevard Pump Station	HVAC
9/19/2011	2105	Supply Fan	Boulevard Pump Station	HVAC
9/19/2011	2106	Exchange Fan - Louvres	Boulevard Pump Station	HVAC
9/19/2011	2107	Exchange Fan - Louvres	Boulevard Pump Station	HVAC
9/19/2011	2108	HVAC Controls	Boulevard Pump Station	HVAC
9/19/2011	2109	HVAC Controls	Boulevard Pump Station	HVAC
9/19/2011	2110	Fuel Oil Tank	Boulevard Pump Station	HVAC
9/19/2011	2111	Exchange Fan - Louvres	East Street Pump Station.	HVAC
9/19/2011	2113	Exchange Fan - Louvres	East Street Pump Station.	HVAC
9/19/2011	2114	Hot Water Unit Heaters	East Street Pump Station.	HVAC
9/19/2011	2115	Boiler	East Street Pump Station.	HVAC
9/19/2011	2116	Hot Water Circulation Pumps	East Street Pump Station.	HVAC
9/19/2011	2117	Hot Water Circulation Pumps	East Street Pump Station.	HVAC
9/19/2011	2118	Exchange Fan	East Street Pump Station.	HVAC
9/19/2011	2119	Exchange Fan	East Street Pump Station.	HVAC
9/19/2011	2120	Exchange Fan	East Street Pump Station.	HVAC
9/19/2011	2121	Hot Water Circulation Pumps	East Street Pump Station.	HVAC
9/19/2011	2122	Air Handling Unit	East Street Pump Station.	HVAC
9/19/2011	2123	Exchange Fan	East Street Pump Station.	HVAC
9/19/2011	2124	Heat Recovery Pumps	East Street Pump Station.	HVAC
9/19/2011	2125	Heat Recovery Pumps	East Street Pump Station.	HVAC
9/19/2011	2126	Exchange Fan	State & Union Pump Station	HVAC
9/19/2011	2129	Gas Fired Unit Heaters	State & Union Pump Station	HVAC
9/21/2011	2131	Boiler A & B	East Shore WPAF	HVAC
9/21/2011	2132	Boiler A & B	East Shore WPAF	HVAC

Date:	Photo:	Subject:	Location:	Discipline:
9/21/2011	2133	Condensate Recirculating Pump	East Shore WPAF	HVAC
9/21/2011	2134	Hot Water Circulation Pumps	East Shore WPAF	HVAC
9/21/2011	2135	Heat Exchanger 1 Pump	East Shore WPAF	HVAC
9/21/2011	2136	Heat Exchanger 1 Pump	East Shore WPAF	HVAC
9/21/2011	2137	Controls	East Shore WPAF	HVAC
9/21/2011	2138	Exchange Fans	East Shore WPAF	HVAC
9/21/2011	2139	Exchange Fans	East Shore WPAF	HVAC
9/21/2011	2140	Exchange Fans	East Shore WPAF	HVAC
9/21/2011	2141	Exchange Fans	East Shore WPAF	HVAC
9/21/2011	2142	Air Conditioning Unit	East Shore WPAF	HVAC
9/21/2011	2143	Air Handling Units	East Shore WPAF	HVAC
9/21/2011	2144	Air Handling Units	East Shore WPAF	HVAC
9/21/2011	2145	Air Handling Units	East Shore WPAF	HVAC
9/21/2011	2146	Air Handling Unit & Fans	East Shore WPAF	HVAC
9/21/2011	2161	Air Handling Unit 4	East Shore WPAF	HVAC
9/21/2011	2162	Air Handling Unit 4	East Shore WPAF	HVAC
9/21/2011	2163	Air Handling Unit 5	East Shore WPAF	HVAC
9/21/2011	2164	Air Handling Unit 2	East Shore WPAF	HVAC
9/21/2011	2165	Air Handling Unit 3	East Shore WPAF	HVAC
9/21/2011	2166	Air Handling Unit 3	East Shore WPAF	HVAC
9/21/2011	2168	Air Handling Unit 1	East Shore WPAF	HVAC
9/21/2011	2170	Air Handling Unit 4	East Shore WPAF	HVAC
9/21/2011	2171	Air Conditioning Unit	East Shore WPAF	HVAC
9/21/2011	2180	Exchange Fans	East Shore WPAF	HVAC
9/21/2011	2181	Exchange Fans 1 & 2	East Shore WPAF	HVAC
9/21/2011	2182	Air Handling Unit 1	East Shore WPAF	HVAC
9/21/2011	2183	Air Handling Unit	East Shore WPAF	HVAC
9/21/2011	2184	Exchange Fans	East Shore WPAF	HVAC
9/21/2011	1	Gravity Thickener	East Shore WPAF	Structural
9/21/2011	2	Gravity Thickener	East Shore WPAF	Structural
9/21/2011	3	Gravity Thickener	East Shore WPAF	Structural
9/21/2011	4	Gravity Thickener	East Shore WPAF	Structural
9/21/2011	5	Gravity Thickener	East Shore WPAF	Structural
9/21/2011	6	Holding Tank	East Shore WPAF	Structural
9/21/2011	7	Holding Tank	East Shore WPAF	Structural
9/21/2011	8	Abandoned Thickener	East Shore WPAF	Structural
9/21/2011	9	Abandoned Thickener	East Shore WPAF	Structural
9/21/2011	10	Abandoned Thickener	East Shore WPAF	Structural
9/21/2011	11	Abandoned Thickener	East Shore WPAF	Structural
9/21/2011	12	Abandoned Thickener Building	East Shore WPAF	Structural
9/21/2011	13	Garage	East Shore WPAF	Structural
9/21/2011	14	Garage	East Shore WPAF	Structural
9/21/2011	15	Garage	East Shore WPAF	Structural
9/21/2011	16	Garage	East Shore WPAF	Structural
9/21/2011	17	Garage	East Shore WPAF	Structural
9/21/2011	18	Garage	East Shore WPAF	Structural
9/21/2011	19	Garage	East Shore WPAF	Structural
9/21/2011	20	Garage	East Shore WPAF	Structural
9/21/2011	21	Garage	East Shore WPAF	Structural
9/21/2011	22	Garage	East Shore WPAF	Structural
9/21/2011	23	Maintenance Building	East Shore WPAF	Structural

Date:	Photo:	Subject:	Location:	Discipline:
9/21/2011	24	Maintenance Building	East Shore WPAF	Structural
9/21/2011	25	Maintenance Building	East Shore WPAF	Structural
9/21/2011	26	Tunnel	East Shore WPAF	Structural
9/21/2011	27	Tunnel	East Shore WPAF	Structural
9/21/2011	28	Tunnel	East Shore WPAF	Structural
9/21/2011	29	Abandoned Thickener Building	East Shore WPAF	Structural
9/21/2011	30	Generator Building	East Shore WPAF	Structural
9/21/2011	31	Inlet Works Building	East Shore WPAF	Structural
9/21/2011	32	Inlet Works Building	East Shore WPAF	Structural
9/21/2011	33	Inlet Works Building	East Shore WPAF	Structural
9/21/2011	34	Inlet Works Building	East Shore WPAF	Structural
9/21/2011	35	Inlet Works Building	East Shore WPAF	Structural
9/21/2011	36	Inlet Works Building	East Shore WPAF	Structural
9/21/2011	37	Inlet Works Building	East Shore WPAF	Structural
9/21/2011	38	Inlet Works Building	East Shore WPAF	Structural
9/21/2011	39	Inlet Works Building	East Shore WPAF	Structural
9/21/2011	40	Inlet Works Building	East Shore WPAF	Structural
9/21/2011	41	Administration Building Roof	East Shore WPAF	Structural
9/21/2011	42	Administration Building Roof	East Shore WPAF	Structural
9/21/2011	43	Administration Building Roof	East Shore WPAF	Structural
9/21/2011	44	Administration Building Roof	East Shore WPAF	Structural
9/21/2011	45	Administration Building Roof	East Shore WPAF	Structural
9/21/2011	46	Administration Building	East Shore WPAF	Structural
9/21/2011	47	Administration Building	East Shore WPAF	Structural
9/21/2011	48	Administration Building	East Shore WPAF	Structural
9/21/2011	49	Administration Building	East Shore WPAF	Structural
9/21/2011	50	Administration Building	East Shore WPAF	Structural
9/21/2011	51	Inlet Works Building	East Shore WPAF	Structural
9/21/2011	52	Inlet Works Building	East Shore WPAF	Structural
9/21/2011	53	Primary Tanks	East Shore WPAF	Structural
9/21/2011	54	Primary Tanks	East Shore WPAF	Structural
9/21/2011	55	Primary Tanks	East Shore WPAF	Structural
9/21/2011	56	Primary Tanks	East Shore WPAF	Structural
9/21/2011	57	Primary Tanks	East Shore WPAF	Structural
9/21/2011	58	Primary Tanks	East Shore WPAF	Structural
9/21/2011	59	Primary Tanks	East Shore WPAF	Structural
9/21/2011	60	Primary Tanks	East Shore WPAF	Structural
9/21/2011	61	Primary Tanks	East Shore WPAF	Structural
9/21/2011	62	Sludge Pump Station	East Shore WPAF	Structural
9/21/2011	63	Sludge Pump Station	East Shore WPAF	Structural
9/21/2011	64	Sludge Pump Station	East Shore WPAF	Structural
9/21/2011	65	Clarifiers	East Shore WPAF	Structural
9/21/2011	66	Clarifiers	East Shore WPAF	Structural
9/21/2011	67	Clarifiers	East Shore WPAF	Structural
9/21/2011	68	Clarifiers	East Shore WPAF	Structural
9/21/2011	69	Clarifiers	East Shore WPAF	Structural
9/21/2011	70	Clarifiers	East Shore WPAF	Structural
9/21/2011	71	Clarifiers	East Shore WPAF	Structural
9/21/2011	72	Chlorine Contact Tank	East Shore WPAF	Structural
9/21/2011	73	Chlorine Contact Tank	East Shore WPAF	Structural
9/21/2011	74	Chlorine Contact Tank	East Shore WPAF	Structural

Date:	Photo:	Subject:	Location:	Discipline:
9/21/2011	75	Clarifiers	East Shore WPAF	Structural
9/21/2011	76	Clarifiers	East Shore WPAF	Structural
9/21/2011	77	Clarifiers	East Shore WPAF	Structural
9/21/2011	78	Aeration Tanks	East Shore WPAF	Structural
9/21/2011	79	Aeration Tanks	East Shore WPAF	Structural
9/21/2011	80	Aeration Tanks	East Shore WPAF	Structural
9/21/2011	81	Aeration Tanks	East Shore WPAF	Structural
9/21/2011	82	Primary Tanks	East Shore WPAF	Structural
9/21/2011	83	Aeration Tanks	East Shore WPAF	Structural
9/21/2011	84	Aeration Tanks	East Shore WPAF	Structural
9/21/2011	85	Aeration Tanks	East Shore WPAF	Structural
9/21/2011	86	Sludge Pump Station	East Shore WPAF	Structural
9/21/2011	87	Aeration Tanks	East Shore WPAF	Structural
9/21/2011	88	Aeration Tanks	East Shore WPAF	Structural
9/21/2011	2	Panel Board	East Shore WPAF	Electrical
9/21/2011	3	MCC	East Shore WPAF	Electrical
9/21/2011	5	MCC	East Shore WPAF	Electrical
9/21/2011	6	MCC	East Shore WPAF	Electrical
9/21/2011	7	MCC	East Shore WPAF	Electrical
9/21/2011	8	MCC	East Shore WPAF	Electrical
9/21/2011	9	MCC	East Shore WPAF	Electrical
9/21/2011	10	MCC	East Shore WPAF	Electrical
9/21/2011	16	Panel Board	East Shore WPAF	Electrical
9/21/2011	21	MCC	East Shore WPAF	Electrical
9/21/2011	22	MCC	East Shore WPAF	Electrical
9/21/2011	23	MCC	East Shore WPAF	Electrical
9/21/2011	28	Switchboard	East Shore WPAF	Electrical
9/21/2011	29	Switchboard	East Shore WPAF	Electrical
9/21/2011	33	13.8 kV Switchgear	East Shore WPAF	Electrical
9/21/2011	34	13.8 kV Switchgear	East Shore WPAF	Electrical
9/21/2011	42	Panel Board	East Shore WPAF	Electrical
9/21/2011	43	Panel Board	East Shore WPAF	Electrical
9/21/2011	49	480V Switchgear	East Shore WPAF	Electrical
9/21/2011	50	480V Switchgear	East Shore WPAF	Electrical
9/21/2011	53	480V Switchgear	East Shore WPAF	Electrical
9/21/2011	57	Panel Board	East Shore WPAF	Electrical
9/21/2011	58	Panel Board	East Shore WPAF	Electrical
9/21/2011	59	Panel Board	East Shore WPAF	Electrical
9/21/2011	60	Panel Board	East Shore WPAF	Electrical
9/21/2011	61	Panel Board	East Shore WPAF	Electrical
9/21/2011	62	Panel Board	East Shore WPAF	Electrical
9/21/2011	63	Panel Board	East Shore WPAF	Electrical
9/21/2011	64	MCC	East Shore WPAF	Electrical
9/21/2011	65	MCC	East Shore WPAF	Electrical
9/21/2011	67	Outdoor Substation	East Shore WPAF	Electrical
9/21/2011	68	Outdoor Substation	East Shore WPAF	Electrical
9/21/2011	69	Outdoor Substation	East Shore WPAF	Electrical
9/21/2011	70	Outdoor Substation	East Shore WPAF	Electrical
9/21/2011	73	Panel Board	East Shore WPAF	Electrical
9/21/2011	76	Panel Board	East Shore WPAF	Electrical
9/21/2011	78	MCC	East Shore WPAF	Electrical

Date:	Photo:	Subject:	Location:	Discipline:
9/21/2011	79	Panel Board	East Shore WPAF	Electrical
9/21/2011	80	MCC	East Shore WPAF	Electrical
9/21/2011	84	MCC	East Shore WPAF	Electrical
9/21/2011	86	MCC	East Shore WPAF	Electrical
9/21/2011	98	13.8 kV Substation	East Shore WPAF	Electrical
9/21/2011	101	Panel Boards	East Shore WPAF	Electrical
9/21/2011	103	Panel Boards	East Shore WPAF	Electrical
9/21/2011	105	Panel Boards	East Shore WPAF	Electrical
9/21/2011	107	Panel Boards	East Shore WPAF	Electrical
9/21/2011	112	MCC	East Shore WPAF	Electrical
9/21/2011	113	MCC	East Shore WPAF	Electrical
9/21/2011	116	MCC	East Shore WPAF	Electrical
9/21/2011	117	MCC	East Shore WPAF	Electrical
9/21/2011	118	MCC	East Shore WPAF	Electrical
9/21/2011	121	Panel Boards	East Shore WPAF	Electrical
9/21/2011	124	MCC	East Shore WPAF	Electrical
9/21/2011	125	MCC	East Shore WPAF	Electrical
9/21/2011	126	MCC	East Shore WPAF	Electrical
9/21/2011	127	MCC	East Shore WPAF	Electrical
9/21/2011	128	4.16 kV Switchgear	East Shore WPAF	Electrical
9/21/2011	135	Main Breaker	James Street Pump Station	Electrical
9/21/2011	139	Lighting Panels	James Street Pump Station	Electrical
9/21/2011	147	MCC	Boulevard Pump Station	Electrical
9/21/2011	148	VFD	Boulevard Pump Station	Electrical
9/21/2011	149	Switchboard	Boulevard Pump Station	Electrical
9/21/2011	156	MCC	East Street Pump Station	Electrical
9/21/2011	158	MCC	East Street Pump Station	Electrical
9/21/2011	159	MCC	East Street Pump Station	Electrical
9/21/2011	160	Main Switchgear	East Street Pump Station	Electrical
9/21/2011	164	Generator	East Street Pump Station	Electrical
9/21/2011	171	MCC	East Street Pump Station	Electrical
9/21/2011	187	Switchboard	State & Union Pump Station	Electrical
9/21/2011	191	Switchboard	State & Union Pump Station	Electrical

Appendix B

Sample Assessment Form and Rating Criteria

Client Name

Facilities Audit: Mech.Assessment - General Equipment

Inventory Information:

Equipment Description _____

Manufacturer _____

Model Number _____

Quantity/Type ____/_____

Equipment IDs _____

Installation Date _____

Capacity _____

Motor Manuf. _____

HP/RPM/V/FLA _____

Drive Type _____

Other _____

Insert photo here

Physical Condition Assessment

Condition	1-5/NA	Comment(s)
Corrosion		
Leakage		
Vibration/Noise		
Support/Base Damage		
Paint/Coating Damage		
Labeling Missing (Y/N)		
Other		
Ancillary Items	1-5/NA	Comment(s)
Piping/Valves		
Motors		
Instruments		
Local Control Station/Panel		
Other		

Overall Rating | 1 | 2 | 3 | 4 | 5 |

Equipment Exceptions

1-5	

Comments:

Process Condition Assessment (to be completed at interviews)

	1	2	3	4	5
Reliability					
O&M Performance					
Capacity					
Regulatory					
Overall					

Comments:

Operational History *(Note any operational data available from O&M interviews)*

Performed By: _____ Date: _____

Client Name

Facilities Audit: Mech.Assessment - Chem. Feed Systems

Inventory Information:

Equipment Description _____

Insert photo here

Metering Pumps

Equipment Description _____

Manufacturer _____

Model Number _____

Quantity/Type _____ / _____

Equipment IDs _____

Installation Date _____

Capacity _____

Motor Manuf. _____

HP/RPM/V/FLA _____

Drive Type _____

Bulk Storage Tank Data

Qty	Capacity	Manuf.	Material	ID #s

Day Tank Data

Qty	Capacity	Manuf.	Material	ID #s

Physical Condition Assessment

Components	1-5/NA	Code(s)	Comment(s)
Bulk Storage Tanks			
Day Tanks			
Transfer Pumps			
Metering Pumps			
Piping/Valves			
Instruments			
Local Control Station/Panel			
Motors			

Condition Codes

A Corrosion
B Leakage
C Vibration/Noise
D Support/Base Damage
E Paint/Coating Damage
F Labeling Missing

Overall Rating	1	2	3	4	5

Equipment Exceptions

1-5	

Comments:

Process Condition Assessment (to be completed at interviews)

	1	2	3	4	5
Reliability					
O&M Performance					
Capacity					
Regulatory					
Overall					

Comments:

Operational History *(Note any operational data available from O&M interviews)*

Performed By: _____ Date: _____

Client Name

Facilities Audit: Structural Assessment - Process Tanks

General Information:

Structure Description _____

Use _____

Type Of Construction _____

Year Built _____

LxWxH (above grade) _____

Basement Dimensions _____

Insert photo here

Physical Condition Assessment

	Condition	1-5/NA	Comment(s)
Concrete/Masonry	Corrosion		
	Leakage		
	Cracking		
	Spalling		
	Settling		
	Joint Damage/Failure		
	Exposed Reinfcmt/Aggreg.		
	Pitting		
	Delamination		
	Freeze/Thaw Damage		
Steel	Corrosion		
	Loss of Section		
	Cracking		
	Deformation		
	Fatigue		
	Connection Failure		

Ancillary Items	1-5/NA	Comment(s)
Railings		
Walkways		
Platforms		
Stairs/Ladders		
Hatches/Doors		
Supports		
Cathodic Prot.		

Overall Rating

1	2	3	4	5

Equipment Exceptions

1-5	

Comments:

Process Condition Assessment (to be completed at interviews)

	1	2	3	4	5
Reliability					
O&M Performance					
Capacity					
Regulatory					
Overall					

Comments:

Operational History *(Note any operational data available from O&M interviews)*

Performed By: _____ Date: _____

Client Name

Facilities Audit: Structural Assessment - Building Systems

General Information:

Structure Description _____

Use _____

_____

_____

Type Of Construction _____

Year Built _____

LxWxH (above grade) _____ x _____ x _____

Basement Dimensions _____

Insert photo here

Physical Condition Assessment

	Condition	1-5/NA	Comment(s)
Concrete/Masonry	Corrosion		
	Leakage		
	Cracking		
	Spalling		
	Settling		
	Joint Damage/Failure		
	Exposed Reinfcmt/Aggreg.		
	Pitting		
	Delamination		
	Freeze/Thaw Damage		
Steel	Corrosion		
	Loss of Section		
	Cracking		
	Deformation		
	Fatigue		
	Connection Failure		

Wood	1-5/NA	Comment(s)
Dry Rot		
Warping		
Splitting		
Conn. Failure		
Loss of Section		

Ancillary Items	1-5/NA	Comment(s)
Roof		
Railings		
Walkways		
Platforms		
Stairs/Ladders		
Hatches/Doors		
Fences		

Overall Rating

1	2	3	4	5

Equipment Exceptions

1-5	

Comments:

Process Condition Assessment (to be completed at interviews)

	1	2	3	4	5
Reliability					
O&M Performance					
Capacity					
Regulatory					
Overall					

Comments:

Operational History *(Note any operational data available from O&M interviews)*

_____

_____

_____

Performed By: **Date:**

Client Name

Facilities Audit: I&C/SCADA Assessment

Inventory Information:

Equipment Description
Manufacturer
Model Number
Quantity
Installation Date
Equipment ID
Voltage
Output
Other

Insert photo here

Physical Condition Assessment

Condition	1-5/NA	Comment(s)
Corrosion		
Leakage/Water Damage		
Vibration / Noise		
Supports / Base Damage		
Leakage		
Covers/Doors Missing/Damaged		
Connections Loose/Broken		
Drawings/Labeling Missing		
Insulation Wear		
Evidence of Overheating		
Grounding Missing/Damaged		
Cooling System Broken		
Door Mounted Inst. Damage		
Other		

Overall Rating

1	2	3	4	5

Equipment Exceptions

1-5	

Comments:

Process Condition Assessment (to be completed at interviews)

	1	2	3	4	5
Reliability					
O&M Performance					
Capacity					
Regulatory					
Overall					

Comments:

Operational History *(Note any operational data available from O&M interviews)*

Performed By: _____ Date: _____

Physical Condition Criteria and Ranking Guidelines (Mechanical Summary)

Criteria	Condition	1	2	3	4	5
Corrosion	Surface only	0%	<10%	10%-50%	>50% - 75%	>75%
	Structural	None	None	None	1 location	>1 location
Leakage	Gaskets / Connections	None	Historic only	Drip only	Stream 1 loc	Stream >1 loc
	Holes / Failures	None	None	None	1 location	>1 location
Vibration	Apparent with Noise	None	None	Yes	Yes	Yes
	Non-Structural Damage	None	None	None	Yes	Yes
	Structural Damage	None	None	None	None	Yes
Concrete Pedestals	Surface Cracking / Loose Grout	None	<10%	10%-50%	>50% -75%	>75%
	Through Cracks	None	None	None	<25%	>=25%
	Missing Pieces	None	None	None	None	1 or more
Steel Supports	Surface Corrosion	None	<10%	10%-50%	50%-75%	>75%
	Structural Corrosion	None	None	None	<25%	>=25%
	Missing/Broken Anchors	None	None	None	<25%	>=25%
Apparent Maintenance Needs	Routine PM only	None	None	Yes	Yes	Yes
	Corrective Action	None	None	None	Yes	Yes
	Major rehab or replacement	None	None	None	None	Yes
Piping / Valves	Leaks – gaskets	None	None	Drips only	Stream – 1 loc	Stream - >1 loc
	Leaks – holes / failures	None	None	None	1 location	>1 location
	Corrosion - surface	None	<10%	10%-50%	>50%-75%	>75%
	Corrosion - structural	None	None	None	<20%	>=20%
	Support Damage	None	None	None	<20%	>=20%
Local Panels	Surface corrosion	None	<10%	10%-50%	>50%-75%	>75%
	Structural damage	None	None	None	1 location	>1 location
	Internal corrosion / leakage	None	None	None	Yes	Yes
	Panel Instruments – non-function	None	None	None	<20%	>=20%
Field Instruments	Damage / non-functional devices	None	None	None	<20%	>=20%
	Leakage	None	None	Drips only	Stream – 1 loc	Stream - >1 loc
Electrical Connections	Conduit / J. Box Surface Corrosion	None	None	<20%	>20%-50%	>50%
	Damage / gaps / missing gaskets	None	None	None	1 location	>1 location
	Exposed wiring	None	None	None	1 location	>1 location

Physical Condition Criteria and Ranking Guidelines (Structural Summary)

Criteria	Condition	1	2	3	4	5
Corrosion	Surface only	0%	<10%	10%-50%	>50% - 75%	>75%
Leakage	Cracks/Joints	None	Historic only	Drip only	Stream 1 loc	Stream >1 loc
	Penetrations / Failures	None	None	None	1 location	>1 location
Concrete/Masonry Surface Damage	Cracking (Width of crack)	None	Minor (< 1mm)	Moderate (1-2mm)	Major (>2mm)	Excessive (not serviceable)
	Exposed Reinforcement	None	None	None	1 location	>1 location
	Spalling, Exposed Aggreg., Pitting, Delamination, Freeze/Thaw Damage	0%	0%	<10%	>10% - 30%	>30%
Joint Damage	Deterioration	0%	<10%	10%-50%	>50% - 75%	>75%
Settling	Magnitude	None	Minor	Moderate	Major	Excessive
Steel Damage	Cracking	None	None	None	1 location	>1 location
	Fatigue/Connection Failure	None	None	None	1 location	>1 location
	Deformation	None	Minor	Moderate	Major	Excessive
	Loss of Section	0%	0%	<10%	>10% - 30%	>30%
Wood Damage	Dry Rot	None	None	None	1 location	>1 location
	Warping/Splitting	None	None	None	1 location	>1 location
	Connection Failure	None	None	None	1 location	>1 location
	Loss of Section	0%	0%	<10%	>10% - 30%	>30%
Apparent Maintenance Needs	Routine PM only	None	None	Yes	Yes	Yes
	Corrective Action	None	None	None	Yes	Yes
	Major rehab or replacement	None	None	None	None	Yes
Roof	Leaks - Cracks/Joints	None	Historic only	Drip only	Stream 1 loc	Stream >1 loc
	Leaks - Penetrations / Failures	None	None	None	1 location	>1 location
	Sagging	None	Minor	Moderate	Major	Excessive
	Support Damage	None	None	None	<20%	>=20%
Railings	Surface corrosion	None	<10%	10%-50%	>50%-75%	>75%
	Structural corrosion	None	None	None	1 location	>1 location
	Missing Pieces	None	None	None	None	1 or more
Walkways/Platforms / Stairs/Ladders	Surface corrosion	None	<10%	10%-50%	>50%-75%	>75%
	Loss of Section	0%	0%	<10%	>10% - 30%	>30%
	Cracking	None	None	None	1 location	>1 location
	Fatigue/Connection Failure	None	None	None	1 location	>1 location
	Deformation	None	Minor	Moderate	Major	Excessive
Doors/Hatches	Leaks - Cracks/Joints	None	Historic only	Drip only	Stream 1 loc	Stream >1 loc
	Leaks - Penetrations / Failures	None	None	None	1 location	>1 location
	Missing/Broken Hinges	None	None	None	None	1 or more

Physical Condition Criteria and Ranking Guidelines (Electrical Summary)

Criteria	Condition	1	2	3	4	5
Corrosion	Surface only	None	None	<20%	>20%-50%	>50%
	Structural	None	None	None	1 location	>1 location
Dielectric Leakage	Transformer/Connection Leaks	None	Historic only	Drip only	Stream 1 loc	Stream >1 loc
	Holes / Failures	None	None	None	None	1 location
Vibration	Apparent with Noise	None	None	Yes	Yes	Yes
	Non-Structural Damage	None	None	None	Yes	Yes
	Structural Damage	None	None	None	None	Yes
Electrical Damage	Evidence of Overheating/Arcing	None	None	None	1 location	>1 location
	Evidence of Water Damage	None	None	None	1 location	>1 location
	Grounding Missing/Damaged	None	None	None	1 location	>1 location
	Insulation Wear	None	None	None	1 location	>1 location
	Cooling System Broken	None	None	None	1 location	>1 location
Concrete Pedestals	Surface Cracking / Loose Grout	None	<10%	10%-50%	>50% -75%	>75%
	Through Cracks	None	None	None	<25%	>=25%
	Missing Pieces	None	None	None	None	1 or more
Steel Supports	Surface Corrosion	None	<10%	10%-50%	50%-75%	>75%
	Structural Corrosion	None	None	None	<25%	>=25%
	Missing/Broken Supports	None	None	None	<25%	>=25%
Apparent Maintenance Needs	Routine PM only	None	None	Yes	Yes	Yes
	Corrective Action	None	None	None	Yes	Yes
	Major rehab or replacement	None	None	None	None	Yes
Motor Control Centers/Panels	Breakers Tripped	None	None	1 location	2 locations	>2 locations
	Drawings and Labeling Missing	No	No	No	Yes - One	Yes - Both
Conduit or Junction Box	Corrosion - surface	None	<10%	10%-50%	>50%-75%	>75%
	Corrosion - structural	None	None	None	<20%	>=20%
	Support Damage	None	None	None	<20%	>=20%
	Exposed Wiring	None	None	None	1 location	>1 location
	Damage / gaps / missing gaskets	None	None	None	1 location	>1 location
	Connections Loose/Broken	None	None	None	1 location	>1 location
Door Mounted Inst.	Damage / non-functional devices	None	None	None	<20%	>=20%

Asset Performance Condition Criteria, Weighting and Ranking Guidelines

Criteria	Assessment Level	Weight	Condition	1	2	3	4	5
Capacity	**Process / System**	**31%**	**Ability to meet current capacity**	**Avg. – Yes* Peak – Yes***	**Avg. – Yes* Peak – Yes****	**Avg. – Yes* Peak – No****	**Avg. – Yes** Peak – No****	**Avg. – No** Peak – No****
			Ability to meet future capacity	Avg. – Yes Peak - Yes	Avg. – Yes Peak - No	Avg. – Yes Peak - No	Avg. – No Peak - No	Avg. – No Peak - No
Regulatory	Process / System	5%	Ability to meet current regulations	Yes	Yes	Yes	Yes – with some modification required	No
			Ability to meet future regulations	Yes	Yes – with some modifications required	No	No	No
Reliability	Equipment Group	30%	Average time equipment is available	99-100% (4 days OS)	95-99% (18 days OS)	90-94% (36 days OS)	85-89% (55 days OS)	< 84% (>55 days OS)
O&M Issues	Equipment Group	21%	Frequency of O&M Issues (Excluding Breakdowns)	None	Very Infrequently (Quarterly)	Infrequently (Monthly)	Frequently (Weekly)	Very Frequently (Daily)
Obsolescence	Equipment Group	13%	Equipment Technology	State of the Art / Best Available	Industry standard / "Tried and True"	Technology considered appropriate	Technology nearing obsolescence/ Misapplied	Technology obsolete / out of date

Appendix C

Cost Estimate Calculation Example

As part of the evaluation, Class 5 equipment replacement cost estimates were prepared to provide the Authority with the potential range of costs that may be required to implement the required capital improvements. The Association of the Advancement of Cost Engineering, International (AACE) states that Class 5 cost estimates generally have a range of accuracy of -50% to +100%.

The estimates were based on a 2003 asset valuation database adjusted to address the following factors:

- Staging, including temporary items required to keep critical systems in service
- Contractors' overhead and profit
- General conditions (Division 1 items, including project administration)
- Escalation from the year 2003 dollars in the 2003 asset database to present day dollars, and then from present day dollars to the estimated midpoint of construction.
- Contingency to account for the many unknowns that can be expected when detailed take-offs and vendor quotes have not been obtained, and effort has not yet been expended to detail construction methods and other factors that are critical to replacement costs.

The following provides is a example calculation of the cost estimating factors that have been applied in this evaluation to develop the Class 5 estimate. In this particular example, it is assumed that the piece of equipment to be replaced has a 2003 asset database estimated replacement cost of $10,000.

It should be noted that the escalation from present day dollars to the estimated midpoint of construction is based on the equipment replacement timeframe described in Section 4 for each piece of equipment. For equipment to be replaced within the next 5 years, the cost is escalated 5 years at 3% per year (compounded). For equipment to be replaced within the next 10 years, the cost is escalated 10 years at 3% per year, and for equipment to be replaced within the next 20 years, the cost is escalated 20 years at 3% per year. Based on these cost escalations, replacement costs referenced in this report are in future years' dollars, not in present day dollars.

Example Calculation

Equipment Cost (Year 2003 dollars)	$10,000
Escalation (2003 to Present)	$3,899
SUBTOTAL	$13,899
Ancillary Systems (50%)	$6,950
SUBTOTAL	$20,849
Staging (10%)	$2,085
SUBTOTAL	$22,934
Contingency (50%)	$11,467
SUBTOTAL	$34,400
General Conditions and Insurance (18%)	$6,192
SUBTOTAL	$40,592
Contractor's OH&P (21%)	$8,524
SUBTOTAL	$49,117
Escalation to Midpoint of Construction (3%/yr, 5 yrs)	$7,823
SUBTOTAL	$56,940
USE	$57,000

Range of Probable Costs for an AACE Class 5 Estimate (-50% to +100%):	$28,500	to	$114,000

Appendix D

Equipment Replacement Cost Estimates

Greater New Haven Water Pollution Control Authority
Crtical Equipment Condition Assessment Cost Estimate

Critical Equipment Item:	Property:	Quantity:	Description:	Install. Date:	Cost New: (2003)	Cost New: (2011)	Total System Cost New	Years to Replace:	Total Cost After Escalation	AACE Class V Estimate Range:	
Aeration Blower #1	NEW HAVEN TREATMENT PLANT	1	BLOWER MOTOR COMBO 1	2008	$ 304,655	$ 423,470	$ 461,174	20	$ 2,944,000	$ 1,472,000	$ 5,888,000
	NEW HAVEN TREATMENT PLANT	1	CONTROLS BLOWER 1	1999	$ 27,125	$ 37,704					
Aeration Blower #2	NEW HAVEN TREATMENT PLANT	1	BLOWER MOTOR COMBO 2	2008	$ 304,655	$ 423,470	$ 461,174	20	$ 2,944,000	$ 1,472,000	$ 5,888,000
	NEW HAVEN TREATMENT PLANT	1	CONTROLS BLOWER 2	1999	$ 27,125	$ 37,704					
Aeration Blower #3	NEW HAVEN TREATMENT PLANT	1	BLOWER MOTOR COMBO 3	2008	$ 304,655	$ 423,470	$ 461,174	20	$ 2,944,000	$ 1,472,000	$ 5,888,000
	NEW HAVEN TREATMENT PLANT	1	CONTROLS BLOWER 3	1999	$ 27,125	$ 37,704					
Aeration Blower #4	NEW HAVEN TREATMENT PLANT	1	BLOWER MOTOR COMBO 4	2006	$ 304,655	$ 423,470	$ 461,174	20	$ 2,944,000	$ 1,472,000	$ 5,888,000
	NEW HAVEN TREATMENT PLANT	1	CONTROLS BLOWER 4	1999	$ 27,125	$ 37,704					
Aeration Blower #5	NEW HAVEN TREATMENT PLANT	1	BLOWER MOTOR COMBO 5	1997	$ 304,655	$ 423,470	$ 461,174	20	$ 2,944,000	$ 1,472,000	$ 5,888,000
	NEW HAVEN TREATMENT PLANT	1	CONTROLS BLOWER 5	1999	$ 27,125	$ 37,704					
Bar Screen #1	NEW HAVEN TREATMENT PLANT	1	SCREEN CATENARY	1987	$ 59,601	$ 82,845	$ 97,041	5	$ 398,000	$ 199,000	$ 796,000
	NEW HAVEN TREATMENT PLANT	1	CONVEYOR CATENARY	1987	$ 10,213	$ 14,196					
Bar Screen #2	NEW HAVEN TREATMENT PLANT	1	SCREEN CATENARY	1987	$ 59,601	$ 82,845	$ 97,041	5	$ 398,000	$ 199,000	$ 796,000
	NEW HAVEN TREATMENT PLANT	1	CONVEYOR CATENARY	1987	$ 10,213	$ 14,196					
Grit Collector #1	NEW HAVEN TREATMENT PLANT	1	GRIT COLLECTOR 1	1987	$ 77,636	$ 107,915	$ 107,915	10	$ 513,000	$ 257,000	$ 1,026,000
Grit Collector #2	NEW HAVEN TREATMENT PLANT	1	GRIT COLLECTOR 2	1987	$ 77,636	$ 107,915	$ 107,915	10	$ 513,000	$ 257,000	$ 1,026,000
Grit Collector #3	NEW HAVEN TREATMENT PLANT	1	GRIT COLLECTOR 3	1987	$ 77,636	$ 107,915	$ 107,915	10	$ 513,000	$ 257,000	$ 1,026,000
Grit Collector #4	NEW HAVEN TREATMENT PLANT	1	GRIT COLLECTOR 4	1987	$ 77,636	$ 107,915	$ 107,915	10	$ 513,000	$ 257,000	$ 1,026,000
Grit Classifier #1	NEW HAVEN TREATMENT PLANT	1	GRIT SCREW CLASSIFIER	1987	$ 11,405	$ 15,853	$ 15,853	10	$ 76,000	$ 38,000	$ 152,000
Grit Classifier #2	NEW HAVEN TREATMENT PLANT	1	GRIT SCREW CLASSIFIER	1987	$ 11,405	$ 15,853	$ 15,853	10	$ 76,000	$ 38,000	$ 152,000
Main Sewage Pump #1	NEW HAVEN TREATMENT PLANT	1	N/A	N/A	N/A	$ 75,000	$ 75,000	20	$ 479,000	$ 240,000	$ 958,000
Main Sewage Pump #2	NEW HAVEN TREATMENT PLANT	1	N/A	N/A	N/A	$ 125,000	$ 125,000	20	$ 798,000	$ 399,000	$ 1,596,000
Main Sewage Pump #3	NEW HAVEN TREATMENT PLANT	1	N/A	N/A	N/A	$ 75,000	$ 75,000	20	$ 479,000	$ 240,000	$ 958,000
Main Sewage Pump #4	NEW HAVEN TREATMENT PLANT	1	N/A	N/A	N/A	$ 125,000	$ 125,000	20	$ 798,000	$ 399,000	$ 1,596,000
Main Sewage Pump #5	NEW HAVEN TREATMENT PLANT	1	N/A	N/A	N/A	$ 75,000	$ 75,000	20	$ 479,000	$ 240,000	$ 958,000
Primary Basin #1	NEW HAVEN TREATMENT PLANT	1	PRIMARY CLARIFIERS	1975	$ 5,321,512	$ 7,396,902	$ 7,396,902	20	$ 31,474,000	$ 15,737,000	$ 62,948,000
Primary Basin #2	NEW HAVEN TREATMENT PLANT	1	PRIMARY CLARIFIERS	1975	$ 5,321,512	$ 7,396,902	$ 7,396,902	20	$ 31,474,000	$ 15,737,000	$ 62,948,000
Primary Basin #3	NEW HAVEN TREATMENT PLANT	1	PRIMARY CLARIFIERS	1994	$ 2,660,756	$ 3,698,451	$ 3,698,451	20	$ 15,737,000	$ 7,869,000	$ 31,474,000
Main Building Scrubber	NEW HAVEN TREATMENT PLANT	1	AMBIE SCRUBBER	1993	$ 121,729	$ 169,204	$ 173,374	10	$ 824,000	$ 412,000	$ 1,648,000
	NEW HAVEN TREATMENT PLANT	2	SCRUBBER FLOOR	1985	$ 3,000	$ 4,170					
RJ Scrubber	NEW HAVEN TREATMENT PLANT	1	RJ SCRUBBER	1997	$ 286,034	$ 397,587	$ 418,437	10	$ 1,988,000	$ 994,000	$ 3,976,000
	NEW HAVEN TREATMENT PLANT	1	PUMP SCRUBBER RECIRC 1	1997	$ 7,500	$ 10,425					
	NEW HAVEN TREATMENT PLANT	1	PUMP SCRUBBER RECIRC 2	1997	$ 7,500	$ 10,425					
X-Flow Scrubber	NEW HAVEN TREATMENT PLANT	1	H2S GAS SCRUBBER SYSTEM	1987	$ 20,959	$ 29,133	$ 41,226	10	$ 196,000	$ 98,000	$ 392,000
	NEW HAVEN TREATMENT PLANT	1	PUMP H2S SCRUBBER	1987	$ 6,500	$ 9,035					
	NEW HAVEN TREATMENT PLANT	1	MOTOR H2S SCRUBBER	1987	$ 2,200	$ 3,058					
Primary Scrubbers	NEW HAVEN TREATMENT PLANT	1	ODOR SCRUBBER 1	1997	$ 410,241	$ 570,235	$ 1,888,861	10	$ 8,971,000	$ 4,486,000	$ 17,942,000
	NEW HAVEN TREATMENT PLANT	1	ODOR SCRUBBER 2	1997	$ 410,241	$ 570,235					
	NEW HAVEN TREATMENT PLANT	1	SCRUBBER FAN 1	1998	$ 269,205	$ 374,195					
	NEW HAVEN TREATMENT PLANT	1	SCRUBBER FAN 2	1998	$ 269,205	$ 374,195					
Chemical Feed System	NEW HAVEN TREATMENT PLANT	1	PUMP SODIUM HYDROXIDE 1	1997	$ 3,500	$ 4,865	$ 216,919	20	$ 1,385,000	$ 693,000	$ 2,770,000
	NEW HAVEN TREATMENT PLANT	1	PUMP SODIUM HYDROXIDE 2	1997	$ 3,500	$ 4,865					
	NEW HAVEN TREATMENT PLANT	1	PUMP SODIUM HYDROXIDE 3	1997	$ 3,500	$ 4,865					
	NEW HAVEN TREATMENT PLANT	1	PUMP SODIUM HYDROXIDE 4	1997	$ 3,500	$ 4,865					
	NEW HAVEN TREATMENT PLANT	1	PUMP SODIUM HYDROXIDE 5	1997	$ 3,500	$ 4,865					
	NEW HAVEN TREATMENT PLANT	1	PUMP SODIUM HYDROX TRANSFER	1997	$ 3,500	$ 4,865					
	NEW HAVEN TREATMENT PLANT	1	SODIUM HYDROXIDE TANK	1985	$ 6,500	$ 9,035					
	NEW HAVEN TREATMENT PLANT	1	SODIUM HYDROXIDE TANK	1997	$ 12,406	$ 17,244					
	NEW HAVEN TREATMENT PLANT	1	TANK CHEMICAL	1999	$ 1,750	$ 2,433					
	NEW HAVEN TREATMENT PLANT	2	TANK CHEMICAL	1999	$ 12,000	$ 16,680					
	NEW HAVEN TREATMENT PLANT	1	SULFURIC ACID TANK	1997	$ 1,525	$ 2,120					
	NEW HAVEN TREATMENT PLANT	1	CHEMICAL MIXER SYSTEM	2000	$ 11,000	$ 15,290					
	NEW HAVEN TREATMENT PLANT	1	SODIUM HYPOCHLORITE TANK 1	1997	$ 12,406	$ 17,244					
	NEW HAVEN TREATMENT PLANT	1	SODIUM HYPOCHLORITE TANK 2	1997	$ 12,406	$ 17,244					
	NEW HAVEN TREATMENT PLANT	1	PUMP SULFURIC ACID	1997	$ 3,500	$ 4,865					
	NEW HAVEN TREATMENT PLANT	1	MOTOR-PUMP CHEMICAL	1999	$ 3,000	$ 4,170					
	NEW HAVEN TREATMENT PLANT	1	MOTOR-PUMP CHEMICAL	1999	$ 3,000	$ 4,170					
	NEW HAVEN TREATMENT PLANT	1	MOTOR-PUMP CHEMICAL	1999	$ 3,000	$ 4,170					

Greater New Haven Water Pollution Control Authority
Crtical Equipment Condition Assessment Cost Estimate

Critical Equipment Item:	Property:	Quantity:	Description:	Install. Date:	Cost New: (2003)	Cost New: (2011)	Total System Cost New	Years to Replace:	Total Cost After Escalation	AACE Class V Estimate Range:	
	NEW HAVEN TREATMENT PLANT	1	CHEMICAL CONTROL	1999	$ 17,521	$ 24,354					
	NEW HAVEN TREATMENT PLANT	1	CHEMICAL CONTROL	1999	$ 17,521	$ 24,354					
	NEW HAVEN TREATMENT PLANT	1	CHEMICAL CONTROL	1999	$ 17,521	$ 24,354					
Aeration Tank #1	NEW HAVEN TREATMENT PLANT	1	AERATION BASINS	1975	$ 4,530,000	$ 6,296,700					
Aeration Tank #2	NEW HAVEN TREATMENT PLANT	1	AERATION BASINS	1975	$ 4,530,000	$ 6,296,700	$ 25,186,800	20	$ 107,169,000	$ 53,585,000	$ 214,338,000
Aeration Tank #3	NEW HAVEN TREATMENT PLANT	1	AERATION BASINS	1975	$ 4,530,000	$ 6,296,700					
Aeration Tank #4	NEW HAVEN TREATMENT PLANT	1	AERATION BASINS	1975	$ 4,530,000	$ 6,296,700					
Final Clarifier #1	NEW HAVEN TREATMENT PLANT	1	SECONDARY CLARIFIERS	1975	$ 966,494	$ 1,343,426					
Final Clarifier #2	NEW HAVEN TREATMENT PLANT	1	SECONDARY CLARIFIERS	1975	$ 966,494	$ 1,343,426					
Final Clarifier #3	NEW HAVEN TREATMENT PLANT	1	SECONDARY CLARIFIERS	1975	$ 966,494	$ 1,343,426					
Final Clarifier #4	NEW HAVEN TREATMENT PLANT	1	SECONDARY CLARIFIERS	1975	$ 966,494	$ 1,343,426	$ 10,747,408	10	$ 34,028,000	$ 17,014,000	$ 68,056,000
Final Clarifier #5	NEW HAVEN TREATMENT PLANT	1	SECONDARY CLARIFIERS	1975	$ 966,494	$ 1,343,426					
Final Clarifier #6	NEW HAVEN TREATMENT PLANT	1	SECONDARY CLARIFIERS	1975	$ 966,494	$ 1,343,426					
Final Clarifier #7	NEW HAVEN TREATMENT PLANT	1	SECONDARY CLARIFIERS	1975	$ 966,494	$ 1,343,426					
Final Clarifier #8	NEW HAVEN TREATMENT PLANT	1	SECONDARY CLARIFIERS	1975	$ 966,494	$ 1,343,426					
Hypochlorite Pump #1	NEW HAVEN TREATMENT PLANT	1	PUMP SODIUM HYPOCHLORITE 1	1997	$ 3,500	$ 4,865					
Hypochlorite Pump #2	NEW HAVEN TREATMENT PLANT	1	PUMP SODIUM HYPOCHLORITE 2	1997	$ 3,500	$ 4,865	$ 19,460	20	$ 125,000	$ 63,000	$ 250,000
Hypochlorite Pump #3	NEW HAVEN TREATMENT PLANT	1	PUMP SODIUM HYPOCHLORITE 3	1997	$ 3,500	$ 4,865					
Hypochlorite Pump #4	NEW HAVEN TREATMENT PLANT	1	PUMP SODIUM HYPOCHLORITE 4	1997	$ 3,500	$ 4,865					
Hypochlorite Mixer #1	NEW HAVEN TREATMENT PLANT	1	N/A	N/A	N/A	$ 20,000	$ 40,000	20	$ 256,000	$ 128,000	$ 512,000
Hypochlorrite Mixer #2	NEW HAVEN TREATMENT PLANT	1	N/A	N/A	N/A	$ 20,000					
Plant Water Pump #1	NEW HAVEN TREATMENT PLANT	1	PUMP PLANT WATER 1	1995	$ 38,710	$ 53,806	$ 53,806	5	$ 221,000	$ 111,000	$ 442,000
Plant Water Pump #2	NEW HAVEN TREATMENT PLANT	1	PUMP PLANT WATER 2	2009	$ 38,710	$ 53,806	$ 53,806	20	$ 344,000	$ 172,000	$ 688,000
Plant Water Pump #3	NEW HAVEN TREATMENT PLANT	1	PUMP PLANT WATER 3	2010	$ 38,710	$ 53,806	$ 53,806	20	$ 344,000	$ 172,000	$ 688,000
Plant Water Strainer #1	NEW HAVEN TREATMENT PLANT	1	FLUID STRAINER	2009	$ 40,094	$ 55,730					
Plant Water Strainer #2	NEW HAVEN TREATMENT PLANT	1	FLUID STRAINER	2009	$ 40,094	$ 55,730	$ 167,191	20	$ 1,068,000	$ 534,000	$ 2,136,000
Plant Water Strainer #3	NEW HAVEN TREATMENT PLANT	1	FLUID STRAINER	2009	$ 40,094	$ 55,730					
Gravity Belt Thickener #1	NEW HAVEN TREATMENT PLANT	1	BELT FILTER PRESS	1990	$ 408,668	$ 568,048	$ 572,218	10	$ 2,718,000	$ 1,359,000	$ 5,436,000
	NEW HAVEN TREATMENT PLANT	1	MOTOR BELT FILTER	1992	$ 3,000	$ 4,170					
Gravity Belt Thickener #2	NEW HAVEN TREATMENT PLANT	1	BELT FILTER PRESS	1990	$ 408,668	$ 568,048	$ 572,218	10	$ 2,718,000	$ 1,359,000	$ 5,436,000
	NEW HAVEN TREATMENT PLANT	1	MOTOR BELT FILTER	1992	$ 3,000	$ 4,170					
TWAS Pump #1	NEW HAVEN TREATMENT PLANT	1	PUMP-MOTOR TWAS	1994	$ 5,500	$ 7,645	$ 15,290	20	$ 98,000	$ 49,000	$ 196,000
TWAS Pump #2	NEW HAVEN TREATMENT PLANT	1	PUMP-MOTOR TWAS	1994	$ 5,500	$ 7,645					
TPS Pump #1	NEW HAVEN TREATMENT PLANT	1	PUMP THICKENED SLUDGE	1980	$ 6,500	$ 9,035	$ 18,070	20	$ 116,000	$ 58,000	$ 232,000
TPS Pump #2	NEW HAVEN TREATMENT PLANT	1	PUMP THICKENED SLUDGE	1980	$ 6,500	$ 9,035					
Gravity Thickener	NEW HAVEN TREATMENT PLANT	1	GRAVITY THICKNER	1975	$ 625,435	$ 869,355	$ 869,355	10	$ 4,129,000	$ 2,065,000	$ 8,258,000
Holding Tank	NEW HAVEN TREATMENT PLANT	1	SLUDGE STORAGE TANK	1975	$ 575,652	$ 800,156	$ 800,156	5	$ 3,278,000	$ 1,639,000	$ 6,556,000
Generator	NEW HAVEN TREATMENT PLANT	1	GENERATOR	1980	$ 89,500	$ 124,405	$ 124,405	5	$ 510,000	$ 255,000	$ 1,020,000
Portable 6" Emergency Pump	NEW HAVEN TREATMENT PLANT	N/A	N/A	N/A	N/A	$ 50,000	$ 50,000	10	$ 68,000	$ 34,000	$ 136,000
Total	N/A	N/A	N/A	N/A	$ 50,882,597	$ 71,291,810	$ 71,291,810	11.2	$ 288,975,000	$ 144,501,000	$ 577,950,000

Greater New Haven WPCA
Condition Assessment Cost Estimates- Small Pump Stations

M_PROPERTY	M_QTY	M_ACQ_DATE	M_CRN	Cost New: (2011)	Years to Replace:	Total Cost After Escalation	AACE Class V Estimate Range:	
BARNES PUMP STATION	1	2004	$ 50,000.00	$ 69,500	20	$ 444,000	$222,000	$ 888,000
BARNES PUMP STATION		2006		$ 100,000	20	$ 639,000	$320,000	$1,278,000
JAMES ST. SIPHON PUMP STATION	2	1985	$ 138,628.00	$ 192,693	5	$ 790,000	$395,000	$1,580,000

Appendix E

Inspection Photos

Please refer to attached compact disc entitled "GNHWPCA Condition Assessment Inspection Photos".